November 17, 2006

Mr. Mark Paris
Basic Remediation Company (BRC)
875 West Warm Springs
Henderson, NV 89011

Re.: Nevada Division of Environmental Protection Response to:
Additional Errata Page for the Human Health Risk Assessment Work Plan – Borrow Area dated November 16, 2006
NDEP Facility ID# H-000688

Dear Mr. Paris:

The NDEP has received and reviewed BRC's correspondence identified above and finds that the document is acceptable.

Should you have any questions or concerns, please do not hesitate to contact me at (702) 486-2850x247.

Sincerely,

Brian A. Rakvica, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions

BAR:s

cc: Jim Najima, NDEP, BCA, Carson City
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Brenda Pohlmann, City of Henderson, PO Box 95050, Henderson, NV 89009
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Rob Mrowka, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Girard Page, Clark County Fire Department, 575 East Flamingo Road, Las Vegas, Nevada 89119
Ranajit Sahu, BRC, 311 North Story Place, Alhambra, CA 91801
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Paul Hackenberry, Hackenberry Associates, 550 West Plumb Lane, B425, Reno, NV, 89509

November 16, 2006

Mr. Mark Paris
Basic Remediation Company (BRC)
875 West Warm Springs
Henderson, NV 89011

Re.: Nevada Division of Environmental Protection Response to:
Errata Pages for the Human Health Risk Assessment Work Plan – Borrow Area
dated November 14, 2006
NDEP Facility ID# H-000688

Dear Mr. Paris:

The NDEP has received and reviewed BRC's correspondence identified above and provides comments below.

1. Table 1, footnote e, please correct this footnote to note that volumetric air content is ***total porosity*** minus volumetric water content. Please re-issue Table 1 with the corrected footnote.

Response: *Footnote e has been corrected in the table.*

2. Appendix A-4, RTC 8, please note that for a sensitivity analysis to be valid the parameter being tested (in this case porosity) must be within the range of values included in the sensitivity model runs. If the total porosity from tests on site soils is between 35% and 45% then the referenced sensitivity tests are appropriate. If total porosity is not in that range then the comparison is not valid. A response to this issue is not required, however, the NDEP comments should be included with the document.

Response: *Agreed. The accepted risk assessment work plan, including all comments and response to comments, will be included as an appendix to the risk assessment report.*

Should you have any questions or concerns, please do not hesitate to contact me at (702) 486-2850x247.

Sincerely,

Brian A. Rakvica, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions

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Paul Hackenberry, Hackenberry Associates, 550 West Plumb Lane, B425, Reno, NV, 89509

BRC HUMAN HEALTH RISK ASSESSMENT WORK PLAN

BORROW AREA
CLARK COUNTY, NEVADA

Prepared for:
Basic Remediation Company (BRC)
875 West Warm Springs Road
Henderson, Nevada 89015

Prepared by:
MWH
3321 Power Inn Road, Suite 300
Sacramento, California 95826

OCTOBER 2006

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

October 2, 2006

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) Date
BRC Project Manager

I hereby certify that I also reviewed the document for quality control purposes myself.

October 2, 2006

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) Date
BRC Project Manager

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1 INTRODUCTION

MWH has prepared this Human Health Risk Assessment (HHRA) Work Plan on behalf of Basic Remediation Company (BRC). The purpose of this work plan is to provide the approach and methods for the HHRA to be performed for off-site uses of Borrow Area (Site) soil following excavation. The Borrow Area is within the area proposed for the BRC Corrective Action Management Unit (CAMU) in Clark County, Nevada. Figure 1 shows the location and configuration of the Borrow Area.

Findings of the HHRA are intended to support the use of excavated Borrow Area soils as off-site fill material. BRC's proposed risk assessment approach for the Site follows basic procedures outlined in the U.S. Environmental Protection Agency's (USEPA) *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (USEPA 1989). A full list of guidance documents consulted is provided in the Reference section at the end of this document. This revision of the work plan (Revision 3) also incorporates Nevada Division of Environmental Protection (NDEP) comments dated May 19, 2006 on the April 2006 revision (Revision 0) of the work plan; NDEP comments dated July 10, 2006 on the June 2006 revision (Revision 1) of the work plan; NDEP comments dated August 25, 2006 on the June 2006 revision (Revision 2) of the work plan; and NDEP comments dated November 9, 2006 on the October 2006 revision (Revision 3) of the work plan. NDEP comments and BRC response to comments are provided in Appendix A. Each of these comments and responses will also be included in the HHRA report.

1.1 SITE DESCRIPTION

The following description of the Site was obtained from the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006) submitted to NDEP on February 13, 2006. The Site is comprised of the north and south Borrow Areas, excluding the portion of the Western Ditch that separates these areas. As currently envisioned, soils from the Borrow Area will be used as general backfill material subject to the constraints discussed in Section 2.1.2.

The north Borrow Area is in the southwest portion of the CAMU, north of the Western Ditch, and encompasses an area of approximately 9.3 acres. The north Borrow Area is bordered on the west by the western CAMU boundary along Eastgate Road, on the north by the westernmost portion of the existing landfill (approximately 300 feet north of the Borrow Area), on the east by the southern lobe of the existing landfill, and to the south by the Western Ditch. The north Borrow Area is shown on Figure 1.

The south Borrow Area is in the southwest portion of the CAMU, south of the Western Ditch, and encompasses an area of approximately 8.5 acres. The south Borrow Area is bordered on the west by the western CAMU boundary along Eastgate Road, on the north by the Western Ditch, on the east by vacant land, and to the south by southern CAMU boundary. The south Borrow Area is shown on Figure 1.

As shown in Figure 1, the two areas are bisected by the known contaminated area of the previous Western Ditch, which will not be used as the source of any of the borrow materials. Even though there is no evidence of disposal of any waste materials in the proposed Borrow Area, because the area, in general, lies in the midst of other waste disposal areas, it is possible that some surface contamination due to water run-off and airborne deposition may have occurred. Historically, there have been drainage channels in the Borrow Area created by storm water runoff from adjoining CAMU and plant areas. It is possible that the soil in the Borrow Area has been impacted by runoff from neighboring sites.

Groundwater underlying the Site is known to be contaminated. As discussed in Section 2.1 below, exposure pathways associated with groundwater will not be evaluated in the HHRA. Excavations within the Borrow Area will stop prior to reaching groundwater. A full discussion on groundwater quality will be provided in the conceptual site model (CSM) being prepared for the CAMU. The objective of the various investigations and assessments within the Borrow Area were to demonstrate to NDEP that it is acceptable to use soil within this area as off-site fill material. Because locations for placement of Borrow Area soil as off-site fill material have not been determined for certain, groundwater quality at these locations is unknown. It is expected that most, if not all of the Borrow materials will be used in the BMI industrial complex, including for CAMU construction. Potential Borrow Area material use sites within the BMI industrial complex are shown on Figure 2.

1.2 EXCAVATION AND PROCESSING OF BORROW AREA MATERIAL

Excavation and processing of Borrow Area material will require activity both in the two portions (Northern and Southern) of the Area and in the processing yard adjacent to the Area. Various grades of materials will then be used on and off-site depending on customer needs.

In each of the two portions (Northern and Southern), material will be mass-graded and gathered using a bull dozier and belly scraper in tandem. The dozier will cut or rake the material, creating a soft bed of dirt that can be easily gathered by the belly scraper. Once the material is gathered by the scraper, it will be transported to a central location along the boundary between the Area and the processing center. There, the material will be dumped into a pile to be located into the material crusher. A front loader will place the material on a crusher conveyor belt to be dumped in the actual crusher.

As the material is processed it will be separated into two piles. The first pile is Type II aggregate material. Type II aggregate is a granular, structure material used to construct building pads and roadway beds. This material is of high value and is structural in nature. The second pile is reject sand. This is material that is too small to be included in the Type II material. This material has a smaller granular consistency and is used at bedding material for pipeline construction and in landscape applications. Rejected sand will be stockpiled for use in CAMU construction or in off-site uses such as pipeline bed or landscape applications. Should rejected sand be needed for off-site uses, its use will be subject to the same constraints as Type II material.

The definition of Type II is as follows (Ref: Section 704.03.04, found at http://www.rtcsouthernnevada.com/streets/streets_specsindex.htm). Type II can consist of a distribution of sizes, within acceptable ranges as indicated below. For example, Type II materials can contain materials that pass sieve size No. 16 but only as long as such materials do not comprise less than 15% or more than 40% of the material.

Sieve Sizes	Nom. Sieve Opening (mm)	% of Dry Weight Passing Sieve
1”	25.4	100
¾”	6.35	90-100
No. 4	4.76	35-65
No. 16	1.19	15-40
No. 200	0.074 (74 microns)	2-10

2 CONCEPTUAL SITE MODEL AND SUMMARY OF DATA USABILITY EVALUATION

2.1 CONCEPTUAL SITE MODEL

The CSM is a tool used in risk assessment to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the Site, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining data quality objectives and developing exposure scenarios.

The HHRA will evaluate both current and potential future uses of Borrow Area soils. Currently, the Site is undeveloped. Current and future receptors that may access the property include construction workers involved in the excavation of Borrow Area soil and trespassers.[1] Once Borrow Area soil is excavated and after placement as off-site fill material, potential future receptors would be maintenance workers who may be involved in digging or trenching activities in locations where such soils may have been placed. One of the constraints on the future use of Borrow Area soil is that such soils cannot be placed in environmentally sensitive areas, nor be exposed to ambient conditions (see Section 2.1.2). In addition, the Borrow Area itself is within the CAMU boundary. No viable habitat is present in the Borrow Area based on field observations. The area (except for the intervening portion of the Western Ditch) has already been graded in anticipation of gravel mining. The Western Ditch contains sparse vegetation and no discernable habitat. Thus, current and future ecological impacts at the Borrow Area will not be assessed in the HHRA.

The potentially exposed populations and their potential routes of exposure to on-site soil and off-site fill material are presented in Figure 3 and summarized below.

2.1.1 Potential Impacts to Groundwater

Impacts to groundwater considering the use of Borrow Area soil as off-site fill material will be conducted using the VLEACH vertical migration model and site-specific soil analytical results. The VLEACH modeling will be conducted for the chemicals of potential concern (COPCs) identified in the HHRA.

In order to evaluate heterogeneous soil layers using VLEACH, multiple iterations of VLEACH will be performed, where the output of one run would be used as the input into another run. VLEACH would be run separately for each of the distinctly different soil layers (*e.g.* Borrow material and underlying native soil). For each VLEACH run the user is allowed to input an initial recharge water concentration that comes in the top of the soil layer. At the end of a run, VLEACH provides the concentration in the bottom soil layer and the recharge (or soil moisture) leaving the bottom of the soil layers. Hence from the first VLEACH run for the upper Borrow

[1] Trespassers are assumed to be teenagers from 13 to 19 years of age. Trespasser exposure parameters reflect this age range (see Section 5.1.1).

material the output of soil moisture concentration at the bottom of this soil layer can be used as the input concentration of recharge for the VLEACH evaluation of the subsequent native soil layer below. Likewise the estimated contaminant soil concentration at the bottom of the Borrow material will be used as the initial soil concentration for the upper cell of the underlying native material VLEACH run. Although the use of the model in the fashion is not explicitly mentioned in the VLEACH manual (Model Version 2.2a, USEPA, 1997a), staff at the USEPA Robert S. Kerr Environmental Research Laboratory, Center for Subsurface Modeling Support in Ada, Oklahoma have indicated that this is an appropriate use of the model to account for heterogeneous soil layers.[2]

VLEACH model input values are presented in Table 1. The intent of this evaluation is to predict impacts to groundwater considering the use of Borrow Area soils as off-site fill material. Constraints on the placement of the soil as fill material will ensure that impacts to groundwater will not occur, and therefore exposure pathways associated with groundwater will not be evaluated in the HHRA.

2.1.2 Inter-Media Transfers

Exposure to Site chemicals may be direct, as in the case of impacted soil, or indirect following inter-media transfers. These transfers can be primary or secondary and impacted soil is the initial source. For example, upward migration of volatile organic compounds (VOCs) from impacted subsurface soil into ambient air thereby reaching a point of human inhalation represents a primary transfer.

These inter-media transfers represent the potential migration pathways that may transport one or more chemicals to an area away from the Site where a human receptor could be exposed. Discussions of each of the identified potential transfer pathways are presented below. Figure 3 presents a conceptualized diagram of the inter-media transfers and fate and transport modeling for the HHRA.

Four initial transfer pathways for which chemicals can migrate from impacted soil to other media have been identified. The first of these pathways is volatilization from soil and upward migration from soil into ambient air. The second primary transfer pathway is via fugitive dust emissions

[2] Personal communications between Ken Kiefer (MWH) and Robert Earle (USEPA), September 27, 2006.

into ambient air. The third primary transfer pathway is downward migration of chemicals from soil to groundwater. However, as discussed above, this pathway will be evaluated elsewhere as a constraint to soil placement. Finally, chemicals in soil can be transferred to plants grown in Borrow Area soil via uptake through the roots. The plant uptake pathway is typically evaluated for residential receptors; however, as discussed in Section 2.1.2 below, because the Borrow Area soil will not be used as fill material for residential development, this pathway will not be evaluated in the HHRA.

2.1.3 Potential Human Exposure Scenarios

The following section summarizes Borrow Area soil exposures and the potential human exposure scenarios. For a complete exposure pathway to exist, each of the following elements must be present (USEPA 1989):

- A source and mechanism for chemical release;
- An environmental transport medium (*i.e.*, air, soil);
- A point of potential human contact with the medium; and
- A route of exposure (*e.g.*, inhalation, ingestion, dermal contact).

The Borrow Area soil is proposed for use as fill material for various construction projects. Any such project will involve limited or no post-construction exposures to the Borrow Area soil. The constraints placed on the use of Borrow Area soil as fill material are: (1) the materials will be used in non-residential areas; (2) the placement of soils will be such that there are no exposure pathways for receptors; (3) a minimum soil column height will be maintained between where these soils are placed and the local groundwater such that impacts to groundwater demonstrated via the leaching evaluation are negligible; (4) to the extent possible, these materials will be placed in significant quantities (approximately 50,000 yards) at each location (DBS&A 2006). An additional constraint on the use of Borrow Area soil as fill material is that it will not be placed in environmentally sensitive areas.[3] Therefore, the following presents the primary exposure pathways for each of the potential receptors to Borrow Area soil. These populations

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[3] These areas may include wetlands, National and State parks, critical habitats for endangered or threatened species, wilderness and natural resource areas, marine sanctuaries and estuarine reserves, conservation areas, preserves, wildlife areas, wildlife refuges, wild and scenic rivers, recreational areas, national forests, Federal and State lands that are research national areas, heritage program areas, land trust areas, and historical and archaeological sites and parks. These areas may also include unique habitats such as aquaculture sites and agricultural surface water intakes, bird nesting areas, critical biological resource areas, designated migratory routes, designated seasonal habitats, State designated Natural Areas, State designated areas for protection or maintenance of aquatic life, and particular areas, relatively small in size, important to maintenance of unique biotic communities.

and complete/potentially complete exposure pathways for each of the receptors will be evaluated in the HHRA.

- Construction workers (on-site soil/off-site fill material)
  - incidental soil ingestion*
  - external exposure from soil†
  - dermal contact with soil
  - outdoor inhalation of dust*‡
  - outdoor inhalation of VOCs from soil

- Trespassers (on-site soil)
  - incidental soil ingestion*
  - external exposure from soil†
  - dermal contact with soil
  - outdoor inhalation of dust*‡
  - outdoor inhalation of VOCs from soil

- Outdoor maintenance workers (off-site fill material)
  - incidental soil ingestion*
  - external exposure from soil†
  - dermal contact with soil
  - outdoor inhalation of dust*‡
  - outdoor inhalation of VOCs from soil

*Includes radionuclide exposures.
†Only radionuclide exposures.
‡Includes asbestos exposures.

As indicated above and in Figure 3, outdoor maintenance workers, construction workers, and trespassers could be exposed to chemicals in soil through skin contact, inhalation of VOCs in outdoor air, inhalation of chemicals absorbed to fugitive dust, or incidental ingestion of soil when soiled hands or objects are placed in or near the mouth. For radionuclides, external radiation is also a potential soil-related exposure pathway for all receptors. For asbestos, inhalation of fugitive dust is considered the only potential soil-related exposure pathway for all receptors. Risks to potential nearby, off-site receptors that may be impacted during mining and placement activities will be addressed qualitatively in the uncertainty analysis section of the HHRA based on the risk characterization for the on-site receptors.

2.2 SUMMARY OF DATA USABILITY EVALUATION

This section describes the procedures that will be used to evaluate the acceptability of data for use in the HHRA. Overall, the quality of sample results is a function of proper sample management. Management of samples begins at the time of collection and continues throughout the analysis process. The collection of environmental data in 2006 followed the quality assurance/quality control (QA/QC) procedures identified in the Quality Assurance Project Plan (QAPP; BRC and MWH 2006a)[4] prepared for the BRC project, as well as the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006). Standard operating procedures (SOPs) that are wholly consistent with the risk assessment were followed to ensure that samples were collected and managed properly and consistently and to optimize the likelihood that the resultant data are valid and representative. Field methods are discussed in the field SOPs (BRC and MWH 2006b), the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006), and adhere to practices consistent with the policies of the NDEP.

A QA/QC review of the analytical results will be conducted prior to conducting the HHRA. The analytical data will be reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA 1992a) and USEPA (1989).

2.2.1 Borrow Area HHRA Datasets

A number of investigations have been performed within the Borrow Area since 2000. These include:

- 2000 Environmental Assessment by Parsons Engineering Science, Inc. (Parsons 2000) (Dataset 10);
- 2003 Limited Environmental Phase II Investigation by Geotechnical & Environmental Services, Inc. (GES 2003a,b) (Datasets 26a and 26b);
- 2003 Asbestos Investigation by MWH and Aeolus Inc. (Aeolus 2003); and
- 2006 Soil Investigation by BRC (Dataset 36).

Data from these investigations included in the project database are:

[4] Both the QAPP and SOPs were under review and not yet approved by NDEP at the time of the 2006 Borrow Area sample collection.

- Borings B-1, B-4, B-5, B-8, B-10, and B-12 from the 2000 Parsons environmental assessment;
- Borings B-13, B-14, B-15, and B-16 from the 2003 GES investigation;
- Borings EB-1 through EB-8, B-5, B-10, and PEB-9 through PEB-18 from the 2003 GES investigations;
- Asbestos samples BEC-1Sb, BEC2Sa through BEC5Sa, and BEC1Da though BEC5Da from the 2003 MWH and Aeolus investigation; and
- Borings BP-01 through BP-10 from the 2006 BRC investigation.

All valid data from these investigations will be included in the HHRA. One exception to this is data from sample PEB-10 from the 2003 GES investigation since soils in the vicinity of this sample location will not be used as Borrow Area fill material. Further elimination of any other data will only occur following discussions with and concurrence from NDEP. These datasets do not include several chemicals that are on the project site-related chemicals list. A discussion of those chemicals that are on the site-related chemicals list but that were not analyzed for will be presented in the uncertainty section of the HHRA report. Data validation reports for all of the datasets that will be used in the risk assessment have been submitted and approved by the NDEP.

2.2.2 Overview of the Data Evaluation Process

The primary objective of the data review and usability evaluation is to identify appropriate data for use in the HHRA. The analytical data are reviewed for applicability and usability following procedures in USEPA's (1992a) *Guidance for Data Usability in Risk Assessment (Part A)* and USEPA's (1989) *Risk Assessment Guidance for Superfund (RAGS)*. According to USEPA's *Data Usability Guidance*, there are six principal evaluation criteria by which data are judged for usability in risk assessment. These six criteria are:

- Availability of information associated with Site data;
- Documentation;
- Data sources;
- Analytical methods and detection limits;
- Data review; and

- Data quality indicators (DQIs), including precision, accuracy, representativeness, comparability, and completeness (PARCC).

A summary of these six criteria for determining data usability in the HHRA is described in this section.

2.2.3 Criterion I – Availability of Information Associated with Site Data

The usability analysis of the site characterization data requires the availability of sufficient data for review. The required information is available from documentation associated with the Site data and data collection efforts.

2.2.4 Criterion II – Documentation Review

The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available documentation. For the purposes of this data usability analysis, the chain-of-custody forms prepared in the field will be reviewed and compared to the analytical data results provided by the laboratory to ensure completeness of the data set. Based on the documentation review, all samples analyzed by the laboratory will be correlated to the correct geographic location at the Site. Field procedures that will be verified include documentation of sample times, dates and locations, other sample specific information such as depth below ground surface (bgs) will be reviewed.

The analytical data will be reported in a format that provides adequate information for evaluation, including appropriate QC measures and acceptance criteria. Each laboratory report will describe the analytical method used, provide results on a sample by sample basis along with sample specific detection limits, and provide the results of appropriate QC samples such as laboratory control spike samples, sample surrogates and internal standards (organic analyses only), and matrix spike samples. All laboratory reports, except for asbestos,[5] will provide the documentation required by USEPA's Contract Laboratory Program (USEPA 2000a, 2005a,b,c). This documentation includes chain of custody records, calibration data, QC results for blanks, duplicates, and spike samples from the field and laboratory, and all supporting raw data

[5] At the time of analyses, there were no Nevada-certified laboratories for providing asbestos data that are useful for risk assessment purposes. The recommended method was performed by EMS Laboratory in Pasadena, California. This laboratory is not certified in the State of Nevada, but has California and national accreditation for asbestos analysis.

generated during sample analysis. Reported sample analysis results will be imported into the project database.

2.2.5 Criterion III –Data Sources

The review of data sources is performed to determine whether the analytical techniques used in the site characterization process are appropriate to identify the COPCs in the HHRA. The site data collection activities have been developed to characterize a broad spectrum of chemicals potentially present on the Site. Laboratory analyses for the most recent soil investigation are identified in the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006) and Table 2.

The State of Nevada is in the process of certifying the laboratories used to generate the analytical data. As such, standards of practice in these laboratories follow the quality program developed by the Nevada Revised Statutes (NRS) and are within the guidelines of the analytical methodologies established by the USEPA.

2.2.6 Criterion IV – Analytical Methods and Detection Limits

In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the analytical methods appropriately identify COPCs and whether the detection limits are low enough to allow adequate characterization of risks. At a minimum, this data usability criterion can typically be met by using standard USEPA and U.S. Department of Energy (DOE) analytical methods to analyze samples collected at the Site. USEPA and USDOE methods will be used in conducting the laboratory analysis of samples and are considered the most appropriate method for the respective constituent class.

For the analytical data, the associated reference method is provided in the following guidelines:

- USEPA (2000a) *Contract Laboratory Program Statement of Work for Low Concentration Organic Analysis*;
- USEPA (2005a) *Contract Laboratory Program Statement of Work for Organic Analysis*;
- USEPA (2005b) *Contract Laboratory Program Statement of Work for Inorganic Analysis*;
- USEPA (2005c) *Contract Laboratory Program Statement of Work for Chlorinated Dioxins and Furans Analysis*;

- USEPA (1996a) *Test Methods for Evaluation Solid Wastes, SW-846 Third Edition;*
- USDOE (1997) *Procedures Manual of the Environmental Measurements Laboratory, HASL-300*; and
- Berman and Kolk (2000) *Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material*.

Laboratory reporting limits are based on those outlined in the reference method and the sampling and analysis plan. In accordance with respective laboratory SOPs, the analytical processes include performing instrument calibration, laboratory method blanks, and other verification standards used to ensure QC during the analyses of collected samples. An evaluation of detection limits will be performed using appropriate risk-based screening levels identified in the QAPP (BRC and MWH 2006a).

2.2.7 Criterion V – Data Review

The data review portion of the data usability process focuses primarily of the quality of the analytical data that will be received from the laboratory. A Data Validation Summary Report will be prepared for all data collection efforts. Any analytical errors and/or limitations in the data will be addressed and an explanation for data qualification will be provided in respective data tables.

2.2.8 Criterion VI – Data Quality Indicators

DQIs are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for this project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and the HHRA. The DQIs include PARCC. The QAPP (BRC and MWH 2006a) provides the definitions and specific criteria for assessing DQIs using field and laboratory QC samples and is the basis for determining the overall quality of the data set. Data validation activities include the evaluation of PARCC parameters, and all data not meeting the established PARCC criteria will be qualified during the validation process using the guidelines presented in the National Functional Guidelines for Laboratory Data Review, Organics and Inorganics and Dioxin/Furans (USEPA 1999, 2001a, 2004a, 2005d).

For some analytical results, quality criteria will not be met and various data qualifiers will be added to indicate limitations and/or bias in the data. The definitions for the data qualifiers, or data validation flags, used during validation are those defined in USEPA guidelines (USEPA 1999, 2001a, 2004a, 2005d). Data validation flags indicate when results are considered non-detect (U), estimated (J), or rejected (R). Sample results may be rejected based on findings of serious deficiencies in the ability to properly collect or analyze the sample and meet QC criteria. Only rejected data will be considered unusable for decision-making purposes and rejected analytical results will not be used in the HHRA. Sample results qualified as estimated may be affected by special circumstances and are likely to be quantitatively biased to some degree; estimated analytical results will be used in the HHRA. Data qualified as non-detect represents an analyte or compound that is not detected above the sample quantitative limit and such data will be used in the HHRA. These data usability decisions follow the guidelines provided in USEPA's (1992a) *Guidance for Data Usability in Risk Assessment – Part A.*

2.2.9 Data Adequacy

The concept of data adequacy incorporates: (i) an analytical program that seeks to quantify all relevant Site chemicals that have the potential to affect risk calculations, and (ii) a spatial density of sampling points that provides confidence that the Site has been sufficiently characterized. The risk assessment analytical program for the Site represents a broad suite of analyses that cover all chemicals that might be conceivably expected to be present at elevated levels at the Site as a result of historical operations on the Site or adjacent to the Site.

An evaluation of the adequacy of the sampling for use in risk assessment will be presented in the HHRA report. The evaluation may incorporate the results from three analyses. The first qualitatively evaluates whether the sample collection appears to be adequately representative in relation to the CSM. The second analysis addresses data quality using traditional classical statistics-based process. The third analysis presents a probabilistic analysis of the data.

3 SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR HUMAN HEALTH RISK ASSESSMENT

The broad suite of analytes presented in the project analyte list (Table 2) is considered to be the initial list of potential COPCs at the Site, based on site characterization conducted to date. However, in order to ensure that the HHRA focuses on those substances that contribute the greatest to the overall risk (USEPA 1989); two procedures will be used to identify the COPCs for quantitative evaluation in the HHRA:

- Identification of chemicals with detected levels which are greater than background concentrations (where applicable), and

- Identification of chemicals that are frequently detected at the Site.

As to the latter, chemicals that are infrequently detected within an area will be discussed on a case-by-case basis with NDEP. Consistent with USEPA guidance (1989), compounds reliably associated with Site activities based on historical information will not be eliminated from the HHRA, even if the results of the procedures given in this section indicate that such elimination is possible. The procedure for evaluating COPCs relative to background conditions is presented below.

3.1 Evaluation of Site Concentrations Relative to Background Conditions

USEPA (1989, 2002a,b) guidance allows for the elimination of chemicals from further quantitative evaluation if detected levels are not elevated above naturally occurring levels. Typically for purposes of selecting COPCs for risk assessment, COPCs are chemicals that are shown to be elevated above naturally occurring levels based on statistical analyses. For the purpose of selecting COPCs for the HHRA, appropriate statistical methods will be applied for the comparison with background data. When the results of the statistical analyses indicate that a particular chemical is within background levels, then the chemical will not be identified as a COPC and will not be quantitatively evaluated in the HHRA. That is, a chemical is selected as a COPC based on background conditions if it is determined to be above background levels in any individual background comparison test. A chemical will be excluded as a COPC only if it is determined to be at or below background levels in all statistical comparison tests. The chemical will, however, be addressed qualitatively in the uncertainty analysis section of the HHRA report (USEPA, 2002a). Also consistent with USEPA guidance (2002a), for chemicals that exceed their respective background levels, risks will be calculated considering both background and site-related risks.

Background concentrations of metals and radionuclides considered representative of the Site soils will be evaluated. The comparison of site-related soil concentrations to background levels will be conducted using the soils background data set presented in the draft *Background Soil Summary Report, BMI Complex and Common Area Vicinity* (BRC/TIMET 2006, currently in revision). This soils background data set includes both the Environ (2003) data set and the BRC/TIMET data set collected in 2005. This combined background data set is still draft and has not yet been approved by NDEP.

Background comparisons will be performed using the Quantile test, Slippage test, the *t*-test, and the Wilcoxon Rank Sum test with Gehan modification. The Quantile test, Slippage test, and Wilcoxon Rank Sum test are non-parametric. That is, the tests are distribution free, thus an assumption of whether the data are normally or lognormally distributed is not necessary. The computer statistical software program GISdT® (Neptune and Company 2006), will be used to perform all statistical comparisons, with a decision error of alpha = 0.025. An alpha = 0.025 is adequate to identify differences between the two datasets since multiple statistical tests are proposed (Black 2006).

The Wilcoxon Rank Sum test performs a test for a difference between two population measures of center. This is a non-parametric method that relies on the relative rankings of data values and the measure of center is quantified by the sum of the ranks in both Site and background data. Knowledge of the precise form of the population distributions is not necessary. The Wilcoxon Rank Sum test has less power than the two-sample t-test when the data are in fact normally distributed; however the assumptions are not as restrictive. The GISdT® version of the Wilcoxon Rank Sum test uses the Mantel approach which is equivalent to using the Gehan ranking system.

The Quantile test addresses tail effects which are not addressed in the Wilcoxon rank-sum test. The Quantile test looks for differences in the right tails (upper-end of the data set) rather than central tendency like the Wilcoxon rank-sum test. The Quantile test will be performed using a defined quantile = 0.80.

The Slippage test evaluates whether there are an unreasonable number of site data points that exceed the maximum background value.

Typically an alpha = 0.05 is used to evaluate a statistically significant result. Since several tests will be conducted, a lower alpha is selected. As more tests are performed, it is more likely that a statistically significant result will be obtained purely by chance. Given the use of the multiple statistical tests, an alpha = 0.025 is selected as a reasonable significance level for the COPC selection. Any chemical that resulted in a p value less than 0.025 in one of the four tests will be retained as a COPC. Additionally, these tests are set up with one-sided hypotheses. Consequently, not only are differences between the two samples able to be detected, a directional determination can be made as well (*e.g.*, Site is greater than background).

Cumulative probability plots and side-by-side box-and-whisker plots will also be prepared to evaluate whether the Site data and background data are representative of a single population. These plots will not necessarily be used in the selection of COPCs, but will be presented for qualitative purposes. These plots give a visual indication of the similarities between the Site and background data sets. A determination to eliminate a chemical as a COPC on the basis of these visual indications will be made on a case-by-case basis with NDEP.

3.2 FURTHER SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Initially, as discussed above, the broad-suite analytes are considered to be potential COPCs at the Site. From this list, a preliminary list of COPCs will be derived for purposes of risk assessment that includes chemicals that are:

- Positively identified in at least one sample in a given medium, including: (1) chemicals with no qualifiers attached (excluding non-detect results with unusually high detection limits, if warranted), and (2) chemicals with qualifiers attached that indicate known identities but estimated concentrations (*e.g.*, J-qualified data);
- Detected at levels significantly elevated above levels of the same chemicals detected in associated blank samples (this protocol includes an analyte if it is known to be site-related and its concentration is greater than five times the maximum amount detected in any blank; if the chemical is a common laboratory contaminant [as defined by USEPA 1989], it is included only if its concentration is greater than 10 times the maximum amount detected in any blank);
- Detected at levels significantly elevated above naturally-occurring levels of the same chemicals;
- Tentatively identified but presumed to be present because of association with the Site based on historical information; and
- Transformation (*e.g.*, degradation) products of chemicals demonstrated to be present.

In deriving the preliminary list of COPCs, the following criteria established by USEPA (1989) will also be considered:

<u>Historical Information</u> – Examine historical information on the Site. Chemicals likely to be associated with Site activities, based on historical information, will not be eliminated, even if the results of other “COPC reduction” steps indicate that such elimination is warranted.

<u>Concentration and Toxicity</u> - Aspects of concentration and toxicity will be considered prior to eliminating a chemical as a COPC. For example, weight-of-evidence for human toxicity will be

considered in conjunction with Site exposure concentrations. Thus, Class A carcinogens will be retained as COPCs.

Consistent with Agency for Toxic Substances and Disease Registry (ATSDR) guidance (De Rosa *et al*., 1997), if the maximum dioxins/furans toxic equivalency (TEQ) concentration in an exposure area does not exceed the ATSDR screening value of 50 parts per trillion (ppt), dioxins/furans will generally not be retained as COPCs, following consultation with NDEP. This screening value is consistent with a recent review of the scientific evidence for the risks posed by dioxins (Paustenbach *et al.*, 2006).

Availability of Toxicity Criteria – Some chemicals have not been assigned toxicity criteria (*i.e.*, cancer slope factor [CSF] or reference dose [RfD]). Prior to eliminating such chemicals, structure-activity relationship (SAR) analysis and applicability of surrogate toxicity values will be considered.

Mobility, Persistence and Bioaccumulation – Chemicals that are highly mobile, are persistent or tend to bioaccumulate will generally be retained as COPCs.

Special Exposure Routes – For some chemicals under special site-specific scenarios, certain exposure routes need to be considered carefully before eliminating COPCs.

Treatability – Chemicals that are difficult to treat should remain as COPCs because of their importance during the selection of groundwater remedial alternatives if needed.

Documentation of Rationale – Rationale for the exclusion of any chemicals from the risk assessment will be documented in the HHRA report.

Need for Further Reduction of COPCs – The need for further reduction of COPCs will be considered prior to applying reduction criteria. It may be appropriate to narrow the number of COPCs included in fate and transport modeling by grouping COPCs with similar fate and transport properties. That is, the modeled behavior of a given COPC will likely reflect that of other COPCs with similar properties. The selection of appropriate COPCs to be included in fate and transport modeling will be discussed with, and approval sought from, NDEP prior to modeling. A discussion of the COPCs that are not included in fate and transport modeling will be presented in the uncertainty section of the HHRA report.

Approval by NDEP – NDEP approval will be sought prior to the elimination of any potential COPCs from the HHRA.

Frequency of detection (FOD) is another criterion that may warrant COPC reduction. Chemicals exhibiting a low FOD within a specific exposure area generally will not contribute significantly to risk and hazard estimates when hot spots are not present. USEPA (1989) suggests that chemicals with a FOD less than or equal to five percent, with the exception of metals and known human carcinogens, may be considered for elimination. Prior to eliminating a COPC based on the FOD criteria, (1) any elevated detection limits will be addressed, and (2) data distributions within exposure areas will be considered (*e.g.*, potential hot spots will be assessed). Additionally, the detection of the COPC in all sampled media will be considered. For example, USEPA recommends that a chemical infrequently detected in soil should not be eliminated if it is frequently detected in groundwater and exhibits mobility in soil. As stated above, chemicals that are infrequently detected will be addressed on an exposure area-specific basis and will be discussed on a case-by-case basis with NDEP.

3.3 Summary and Presentation of Chemicals of Potential Concern

A summary of the site COPC data (*i.e.*, chemical, range of concentration, background levels, FOD, retained/eliminated as COPC, and rationale for elimination) will be presented in table form. Any additional discussion of COPC selection will be made in the text as necessary.

4 DETERMINATION OF REPRESENTATIVE EXPOSURE CONCENTRATIONS

A representative exposure concentration is a COPC-specific and media-specific concentration value used in the dose equation for each receptor and each exposure pathway. As described below, the methods, rationale, and assumptions employed in deriving the representative exposure concentrations will be consistent with USEPA guidance and will reflect site-specific conditions.

4.1 Soil

The HHRA will incorporate representative exposure concentration estimates (*e.g.*, 95 percent upper confidence limit [UCL] on the arithmetic mean [USEPA 1992b, 2002c]) that specifically relate to potential site-specific human exposure conditions. For the 95 percent UCL concentration approach, the 95 percent UCL will be computed in order to represent the area-wide exposure point concentrations. The UCL incorporates the uncertainty of the estimate of the mean and is the value that, with repeated sets of samples, will be greater than the true mean 95 percent of the time. Based on USEPA (1989) guidance, non-detects for COPCs will be assigned a value of one-half the detection limit. Other methods for addressing non-detects may be considered. For radionuclide uncensored data, the actual reported value will be used. Data identified in the data usability evaluation as unusable due to elevated reporting limits will not be used in the calculation of representative exposure concentrations. The formulas for calculating the 95 percent UCL COPC concentration (as the representative exposure concentration) are presented in USEPA (1992b, 2002c). The 95 percent UCL statistical calculations will be performed using the computer statistical software program GISdT® (Neptune and Company 2006).

The 95 percent UCL of the arithmetic mean concentration is used as the average concentration, because it is not possible to know the true mean. The 95 percent UCL, therefore, accounts for uncertainties due to limited sampling data. An estimate of average concentration is used because: carcinogenic and chronic non-carcinogenic toxicity criteria are based on lifetime average exposures; and, average concentration is most representative of the concentration that would be contacted at a site, over time (USEPA 1992b).

Representative exposure concentrations for soil are typically based on the potential exposure depth for each of the receptors. However, given that the HHRA will assess exposures to soil following excavation and use as off-site fill material, it is proposed that a 95 percent UCL be generated for all data collected within the excavation extent and depth. This 95 percent UCL will be used for all potentially exposed receptors. For indirect exposures, this concentration will be used in fate and transport modeling.

4.2 OUTDOOR AIR

Long–term exposure to COPCs bound to dust particles will be evaluated using the USEPA’s Particulate Emission Factor (PEF) approach (USEPA 2002d). The PEF relates concentrations of a chemical in soil to the concentration of dust particles in the air. The Q/C (Site-Specific Dispersion Factor [USEPA 2002d]) values in this equation will be for Las Vegas, Nevada (Appendix D of USEPA 2002d; see Table 2). The USEPA guidance for dust generated by construction activities (USEPA 2002d) will be used for short-term on-site and off-site construction worker exposures. Input soil concentrations for the model will be the 95 percent UCL concentrations as described above. For exposures to VOCs in outdoor air, the USEPA volatilization factor approach will be used (USEPA 2002d). The same volatilization factors will be used for all scenarios. The volatilization factors for the construction worker will not be adjusted to account for soil intrusion activities. Soil intrusion associated with construction activities could results in increased volatilization from the subsurface to outdoor. However, the volatilization factors to be used are conservative and are not likely to underestimate exposures. Fate and transport model input values are presented in Table 3.

5 HUMAN HEALTH RISK ASSESSMENT APPROACH

The following risk assessment approach will be conducted for all COPCs, with the exception of lead. A project-specific cleanup goal of 400 mg/kg has been established for lead during previous meetings with NDEP.

5.1 DETERMINISTIC HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The deterministic risk assessment will follow procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund: Volume I -Human Health Evaluation Manual* (USEPA 1989). Other guidance documents that will be relied on include:

- *Guidelines for Exposure Assessment*. USEPA. 1992c.
- *Exposure Factors Handbook, Volumes I-III*. USEPA 1997b.
- *Soil Screening Guidance: Technical Background Document*. USEPA 1996b.
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. USEPA 2002d.
- *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual*. Supplemental Guidance. USEPA. 1991.
- Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96. NDEP. 1996.

5.1.1 Deterministic Exposure Parameters

The exposure parameters proposed to be used in the deterministic risk assessment are presented in Tables 4 through 6. These conservative default values are primarily based on standard USEPA guidance values. In some instances standard USEPA guidance values are unavailable. This is the case for trespasser exposure frequency and time. In these instances, professional judgment was used to select appropriate exposure factors. For the trespasser exposure frequency and time, it is assumed that a trespasser could access the Site for 50 days per year (or one day per week) and spend four hours on the Site per visit. Exposure parameters that have significant impact on the results will be discussed in the uncertainty section of the HHRA report.

5.1.2 Deterministic Exposure Assessment

Reasonable maximum exposure levels to chemicals will be calculated for each receptor of concern, using the exposure parameters identified in Tables 4 through 6. The methodology used to estimate the average daily dose (ADD) of the chemicals via each of the complete exposure pathways is based on USEPA (1989, 1992c) guidance. For carcinogens, lifetime ADD (LADD) estimates are based on chronic lifetime exposure extrapolated over the estimated average 70-year lifetime (USEPA 1989). This is performed in order to be consistent with CSFs, which are based on chronic lifetime exposures. For non-carcinogens, ADD estimates will be averaged over the estimated exposure period. The generic equation for calculating the ADDs and LADDs is:

$$Dose = \frac{C \times IR \times ED \times EF \times BIO}{BW \times AT \times 365\ d/yr}$$

where:

Dose	=	ADD for non-carcinogens and LADD for carcinogens (in mg/kg-day)
C	=	chemical concentration in the contact medium (mg/kg soil)
IR	=	intake rate (*e.g.*, mg/day soil ingestion and dermal contact; m^3/day for inhalation)
ED	=	exposure duration (years of exposure)
EF	=	exposure frequency (number of days per year)
BW	=	average body weight over the exposure period (kilograms)
BIO	=	relative bioavailability (unitless)
AT	=	averaging time; same as the ED for non-carcinogens and 70 years (average lifetime) for carcinogens

With the exception of arsenic, the relative oral bioavailability (BIO) of all COPCs will be 100 percent. For arsenic, consistent with scientific literature recommendations on arsenic bioavailability (Roberts *et al*. 2001; Ruby *et al*. 1999; USEPA 2001b), an arsenic oral bioavailability of 30 percent will be used. The actual oral bioavailability of arsenic (as well as other metals at the Site, for which an oral bioavailability of 100 percent will be used) is likely to be lower than this value. Chemical-specific dermal absorption values from USEPA guidance (USEPA 2004b [Part E RAGS]) will be used in the HHRA.

Exposure levels of potentially-carcinogenic and non-carcinogenic chemicals will be calculated separately because different exposure assumptions apply (*i.e.*, ADD for non-carcinogens and LADD for carcinogens). Exposure levels will be estimated for each relevant exposure pathway (*i.e.*, soil, air), and for each exposure route (*i.e.*, oral, inhalation, and dermal). Daily doses for the same route of exposure will be summed. The total dose of each chemical is the sum of doses across all applicable exposure routes.

The results of the exposure assessment will be used with information on the toxicity of the COPCs in the risk characterization step of the HHRA to estimate the potential risks to human health posed by exposure to the COPCs. This process is discussed in Section 7.

5.2 RADIONUCLIDE RISK ASSESSMENT METHODOLOGY

Risks associated with radionuclides will be evaluated separately from chemicals. Recently available USEPA risk assessment methodologies for radionuclides will be used (USEPA 2000b). There are several important differences between evaluating risks pertinent to radionuclides and those pertinent to chemicals. These differences include:

- Concentrations are based on units of activity (*e.g.*, pCi) instead of units of mass (*e.g.*, mg) in soil;
- Only the carcinogenic effects of radionuclides due to ionizing radiation are considered. A radionuclide may also have a chemical toxicity (*e.g.* uranium or lead). These risks are addressed separately by using the concentration of mass of chemical in soil, rather than activity; and
- CSFs are based on the total theoretical age-averaged incremental lifetime cancer risk per intake of the radionuclide, or per unit external radiation exposure to gamma-emitting radionuclides. An adult only soil ingestion CSF is available and will be used for all receptors. Except for external CSFs, which are presented as risk/year per pCi/g soil, CSFs for radionuclides are not expressed as a function of body weight or time as are CSFs for chemicals.

Exposure equations and parameter values used will be the standard deterministic risk assessment exposure parameters based on typical USEPA (2000b, 2006a) default values. The exposure equations are modified to include radionuclide decay as used in USEPA's radionuclide PRG equations (USEPA 2006a). Default parameter values are presented in Tables 4 through 6. These factors will also be used in the calculation of background radionuclide risk levels.

5.3 ASBESTOS RISK ASSESSMENT METHODOLOGY

Although final guidance is unavailable at this time, USEPA recommends that site-specific risk assessments be performed for asbestos (USEPA 2004d). Risks associated with asbestos in soil will be evaluated using the most recent draft methodology proposed by USEPA (2003b). This methodology is an update of the method described in *Methodology for Conducting Risk Assessments at Asbestos Superfund Sites-Part 1: Protocol* and *Part 2: Technical Background Document* (Berman and Crump, 1999a,b). Exposure pathways, equations, and parameters to be used will be those presented in USEPA (2003b). Adjustments for exposure duration and exposure intensity, consistent with the methodology, will be made for each of the receptor populations, based on the respective exposure parameters presented in Tables 4 through 6.

The exposure point concentration for asbestos is based on the pooled analytical sensitivity of the dataset. The pooled analytical sensitivity is calculated as follows:

$$\textit{Pooled Analytical Sensitivity} = 1/\left[\sum_i (1/\textit{analytical sensitivity for trial } i)\right]$$

Two estimates of the asbestos concentration will be evaluated. The estimate of the mean asbestos concentration is the number of asbestos fibers detected multiplied by the pooled analytical sensitivity. The upper bound estimate is the upper confidence bound of the mean of the assumed underlying Poisson distribution used to model the number of structures found multiplied by the pooled analytical sensitivity. The intent of the risk assessment methodology is to predict the amount of airborne asbestos which can be inhaled by a receptor. In addition, it will be assumed that asbestos only occurs at the soil surface (*i.e.*, upper two inches).

For assessing asbestos risks, Table 8-2 (Based on Optimum Risk Coefficients) of USEPA (2003b) will be used. Population averaged risks will be evaluated based on Eqn. 8-1 of USEPA (2003b). This equation considers male smokers, male non-smokes, female smokers, and female non-smokers. In addition, because both chrysotile and amphibole have been detected in the general area (for example, from the City of Henderson wastewater reclamation facility [WRF] sampling), both could be expected to occur at the Site. Therefore, both amphibole and chrysotile fibers will be conservatively evaluated in the HHRA, regardless as to whether either is detected (as calculated using the 95 percent UCL of the mean of the assumed underlying Poisson distribution).

To interpret measurements of asbestos in soils, it is necessary to establish the relationship between the asbestos concentrations observed in soils and concentrations that will occur in air when such soil is disturbed by natural or anthropogenic forces. This is because asbestos is a hazard when inhaled (see, for example, USEPA 2003b). In fact, the Modified Elutriator Method (Berman and Kolk 2000), which was the method employed to perform the analyses to be used in the HHRA, was designed specifically to facilitate prediction of airborne asbestos exposures based on bulk measurements (see, for example, Berman and Chatfield 1990). The method of sample preparation and analysis for asbestos involves collection of composite samples that are re-suspended and then forced through an airway and filter. Because of this, coupled with the very low response (few detections), there is probably very limited value, if any, to compositing the samples before analysis.

6 TOXICITY ASSESSMENT

This section identifies how toxicity values to be used for the HHRA will be obtained. Toxicity values are published by the USEPA in the on-line Integrated Risk Information System [IRIS]; USEPA 2006b). CSFs are chemical-specific and experimentally derived potency values that are used to calculate the risk of cancer resulting from exposure to potentially carcinogenic chemicals. A higher value implies a more potent carcinogenic potential. RfDs are experimentally derived “no-effect” levels used to quantify the extent of toxic effects other than cancer due to exposure to chemicals. With RfDs, a lower value implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in the USEPA risk assessment guidance documents and databases. Toxicity criteria will not be developed *de novo* by BRC for elements or compounds that do not have criteria published in the above sources. Should COPCs be found which do not have established toxicity criteria; these will be discussed on a case-by-case basis with NDEP and qualitatively addressed in the uncertainty analysis of the HHRA report. Where appropriate, and only as approved by NDEP, non-carcinogenic surrogate RfDs may be applied.

Like any biological reaction, the toxicity of a chemical on humans can be described as a range of possible outcomes (severities and levels that cause an endpoint of concern). Available toxicity values for all Site COPCs to be used in the HHRA will be obtained from the USEPA. The following hierarchy for selecting toxicity criteria will be used (based on USEPA 2003c):

1. IRIS

2. USEPA’s Provisional Peer Reviewed Toxicity Values (PPRTVs)

3. National Center for Environmental Assessment (NCEA, or other current USEPA sources)

4. Health Effects Assessment Summary Tables (HEAST)

5. USEPA Criteria Documents (*e.g.*, drinking water criteria documents, drinking water Health Advisory summaries, ambient water quality criteria documents, and air quality criteria documents)

6. Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles

7. USEPA's Environmental Criteria and Assessment Office (ECAO)

8. Peer-reviewed scientific literature

For carcinogens, the USEPA weight-of-evidence classification will be identified for each carcinogenic COPC. Available RfDs will be obtained for all COPCs, including carcinogens. A list of COPC-specific non-carcinogenic and carcinogenic toxicity criteria, current at the time of the HHRA, will be submitted to NDEP for approval prior to initiation of the risk assessment. Radionuclides toxicity criteria will be obtained from the USEPA's *Radionuclide Toxicity and Preliminary Remediation Goals for Superfund* (USEPA 2006a). For some radionuclides, two different toxicity criteria are available: for that radionuclide only, and for the radionuclide and associated short-lived radioactive decay products (*i.e.,* those decay products with radioactive half-lives less than or equal to six months). To be conservative, the toxicity criteria that include radioactive decay products will be used, even though toxicity criteria are available for some of their respective radioactive decay products, which are also assessed separately.

Although route-to-route extrapolation is generally inappropriate without adequate toxicological information, in this case route-to-route extrapolation will be applied based on USEPA's approach (USEPA 2004c). The uncertainties associated with this approach will be addressed in the HHRA report. CSFs that account for risks from associated short-lived radioactive decay products (*i.e.*, radon) will be used in the HHRA.

Although USEPA has developed toxicity criteria for the oral and inhalation routes of exposure, it has not developed toxicity criteria for the dermal route of exposure. USEPA has proposed a method for extrapolating oral toxicity criteria to the dermal route in the recently released *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA 2004b). Although a review draft, USEPA stated that the adjustment of the oral toxicity factor for dermal exposures is necessary only when the oral-gastrointestinal absorption efficiency of the chemical of interest is less than 50 percent (due to the variability inherent in absorption studies).

For the dioxins/furans (CDD/CDFs), the USEPA toxicity equivalency procedure, developed to describe the cumulative toxicity of these compounds, will be applied. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the 2,3,7,8 substituted CDD/CDF congeners. TEFs are estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1.0. Calculating the toxic equivalency (TEQ) of a mixture involves multiplying the concentration of individual congeners by their respective TEF. One-half the detection limit will be used for calculating the TEQ for individual congeners that are non-detect in a particular sample. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture. TEFs from USEPA (2000c) will be used in the HHRA.

For carcinogenic polycyclic aromatic hydrocarbons (PAHs), provisional USEPA guidance for estimating cancer risks will be used (USEPA 1993). The procedure uses information from the scientific literature to estimate the carcinogenic potency of several PAHs relative to benzo(a)pyrene. These relative potencies may be used to modify the CSF developed for benzo(a)pyrene for each PAH, or to calculate benzo(a)pyrene equivalent concentrations for each of the PAH's (which would then be used with the benzo(a)pyrene CSF). The former approach will be used in the HHRA. If one carcinogenic PAH is considered a COPC then all seven carcinogenic PAHs will be considered COPCs, regardless of whether or not they were detected at the Site. Although route-to-route extrapolation is inappropriate without adequate toxicological information, route-to-route extrapolation will be applied based on USEPA's approach.

The USEPA has not derived toxicity criteria to evaluate the potential non-cancer health hazards associated with exposure to the carcinogenic PAH COPCs. For the HHRA, a toxicological surrogate (*i.e.*, pyrene) will be used to quantify the potential non-carcinogenic effects of the carcinogenic PAHs. This surrogate was selected from a list of six PAHs for which non-cancer oral toxicity criteria have been assigned by the USEPA based on a careful consideration of their relevant toxicity data, target organ(s), dose-response information, and structure-activity relationships. From the available oral non-cancer toxicity data reported by the USEPA, the most sensitive target organs are the liver, kidney, and blood (hematological effects) (IRIS, USEPA 2006b; ATSDR 1990, 1995; ORNL 1993). For the carcinogenic PAHs, the non-cancer target organs were found to be the same and the reported toxicological thresholds for these effects are generally in the range for those reported for the non-cancer PAHs (ATSDR 1995). Although naphthalene (2-ring structure) has the most stringent oral non-cancer toxicity criterion (0.02 mg/kg day), pyrene (4-ring structure; oral reference dose of 0.03 mg/kg-day) was selected to be the best surrogate due to (1) non-cancer toxicity endpoints are more consistent with those for carcinogenic PAHs and (2) the greater number of rings in the pyrene chemical structure.

7 RISK CHARACTERIZATION

In the last step of a risk assessment, the estimated rate at which a person intakes a COPC is compared with information about the toxicity of that COPC to estimate the potential risks to human health posed by exposure to the COPC. This step is known as risk characterization. In the risk characterization, cancer risks will be evaluated separately from non-cancer adverse health effects. The methods used for assessing cancer risks and non-cancer adverse health effects are discussed below.

7.1 METHODS FOR ASSESSING CANCER RISKS

In the risk characterization, carcinogenic risk will be estimated as the incremental probability of an individual developing cancer over a lifetime as a result of a chemical exposure. Carcinogenic risks will be evaluated by multiplying the estimated average exposure rate (*i.e.*, LADD calculated in the exposure assessment) by the chemical's CSF. The CSF converts estimated daily doses averaged over a lifetime to incremental risk of an individual developing cancer. Theoretical risks associated with low levels of exposure in humans are assumed to be directly related to an observed cancer incidence in animals associated with high levels of exposure. According to USEPA (1989), this approach is appropriate for theoretical upper-bound incremental lifetime cancer risks of less than 1×10^{-2}. The following equations will be used to calculate chemical-specific risks and total risks:

$$Risk = LADD \times CSF$$

where:

LADD	=	lifetime average daily dose (mg/kg-d)
CSF	=	cancer slope factor $(mg/kg\text{-}d)^{-1}$

and

$$Total\ Carcinogenic\ Risk = \Sigma\, Individual\ Risk$$

It will be assumed that cancer risks from various exposure routes are additive. Thus, the result of the assessment is necessarily a high-end estimate of the total carcinogenic risk. High-end carcinogenic risk estimates will be evaluated by NDEP in light of site-specific risk management decision criteria.

7.2 METHODS FOR ASSESSING NON-CANCER HEALTH EFFECTS

Non-cancer adverse health effects are estimated by comparing the estimated average exposure rate (*i.e.*, ADDs estimated in the exposure assessment) with an exposure level at which no adverse health effects are expected to occur for a long period of exposure (*i.e.*, the RfDs).

ADDs and RfDs are compared by dividing the ADD by the RfD to obtain the ADD:RfD ratio, as follows:

$$Hazard\ Quotient\ =\ \frac{ADD}{RfD}$$

where:

ADD	=	average daily dose (mg/kg-d)
RfD	=	reference dose (mg/kg-d)

The ADD-to-RfD ratio is known as a hazard quotient. If a person’s average exposure is less than the RfD (*i.e.*, if the hazard quotient is less than 1), the chemical is considered unlikely to pose a significant non-carcinogenic health hazard to individuals under the given exposure conditions. Unlike carcinogenic risk estimates, a hazard quotient is not expressed as a probability. Therefore, while both cancer and non-cancer risk characterizations indicate a relative potential for adverse effects to occur from exposure to a chemical, a non-cancer adverse health effect estimate is not directly comparable with a cancer risk estimate.

If more than one pathway is evaluated, the hazard quotients for each pathway, for all COPCs, will be summed to determine whether exposure to a combination of pathways poses a health concern. This sum of the hazard quotients is known as an HI.

$$Hazard\ Index = \Sigma\, Hazard\ Quotients$$

A total HI that includes all COPCs and all exposure pathways will be presented in the HHRA. The NDEP non-cancer risk management target is an HI value of less than or equal to 1.

For any HI that exceeds 1, the potential for adverse health effects will be further evaluated by considering the target organs upon which each chemical could have an adverse effect. Target organ-specific HIs will be assessed only after approval by NDEP. The target organ specific HIs will be summed for all relevant COPCs. The segregation of HI by target organ is consistent with USEPA guidance for non-carcinogens, including metals (USEPA 1989, 1998, 2001c).

8 UNCERTAINTY ANALYSIS

Consistent with USEPA (1989) guidance, for the deterministic risk assessment, a qualitative discussion of the uncertainties associated with the estimation of risks for the Site will be presented in the HHRA report. The uncertainty analysis will discuss uncertainties associated with each step of the risk assessment, including site characterization data, data usability, selection of COPCs, representative exposure concentrations, fate and transport modeling, exposure assessment, toxicity assessment, and risk characterization. For both non-carcinogens and carcinogens, the relative contribution of specific COPCs and pathways to total risk and HI will be identified.

9 INTERPRETATION OF FINDINGS

The risk characterization results will be presented in tabular format in the HHRA report. Key exposure (*e.g.*, estimated intakes, important modeling assumptions, summary of exposure pathways for each receptor) and toxicity information (*e.g.*, CSFs, RfDs, target organs) will be provided. In addition, the risk characterization results will be placed into proper perspective, including a discussion of the concept of *de minimis* risk. The cancer risk assessment results will be presented for both total cancer risk and background cancer risk estimates, as well as presentation of the percent contribution of the background cancer risk to the total cancer risk. In addition, those COPCs and exposure pathways having the greatest influence on the risk assessment results will be identified. As appropriate, graphical presentation of the results will also be included in the HHRA report.

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REDLINE VERSION

BRC HUMAN HEALTH RISK ASSESSMENT WORK PLAN

BORROW AREA
CLARK COUNTY, NEVADA

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~~JULY~~ OCTOBER 2006

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

October 2, 2006

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) Date
BRC Project Manager

I hereby certify that I also reviewed the document for quality control purposes myself.

October 2, 2006

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) Date
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1 INTRODUCTION

MWH has prepared this Human Health Risk Assessment (HHRA) Work Plan on behalf of Basic Remediation Company (BRC). The purpose of this work plan is to provide the approach and methods for the HHRA to be performed for off-site uses of Borrow Area (Site) soil following excavation. The Borrow Area is within the area proposed for the BRC Corrective Action Management Unit (CAMU) in Clark County, Nevada. Figure 1 shows the location and configuration of the Borrow Area.

Findings of the HHRA are intended to support the use of excavated Borrow Area soils as off-site fill material. BRC's proposed risk assessment approach for the Site follows basic procedures outlined in the U.S. Environmental Protection Agency's (USEPA) *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (USEPA 1989). A full list of guidance documents consulted is provided in the Reference section at the end of this document. This revision of the work plan (Revision ~~2~~3) also incorporates Nevada Division of Environmental Protection (NDEP) comments dated May 19, 2006 on the April 2006 revision (Revision 0) of the work plan; ~~and~~ NDEP comments dated July 10, 2006 on the June 2006 revision (Revision 1) of the work plan; ~~and~~ NDEP comments dated August 25, 2006 on the June 2006 revision (Revision 2) of the work plan; and NDEP comments dated November 9, 2006 on the October 2006 revision (Revision 3) of the work plan. NDEP comments and BRC response to comments are provided in Appendix A. Each of these comments and responses will also be included in the HHRA report.

1.1 SITE DESCRIPTION

The following description of the Site was obtained from the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006) submitted to NDEP on February 13, 2006. The Site is comprised of the north and south Borrow Areas, excluding the portion of the Western Ditch that separates these areas. As currently envisioned, soils from the Borrow Area will be used as general backfill material subject to the constraints discussed in Section 2.1.2.

The north Borrow Area is in the southwest portion of the CAMU, north of the Western Ditch, and encompasses an area of approximately 9.3 acres. The north Borrow Area is bordered on the west by the western CAMU boundary along Eastgate Road, on the north by the westernmost portion of the existing landfill (approximately 300 feet north of the Borrow Area), on the east by the southern lobe of the existing landfill, and to the south by the Western Ditch. The north Borrow Area is shown on Figure 1.

The south Borrow Area is in the southwest portion of the CAMU, south of the Western Ditch, and encompasses an area of approximately 8.5 acres. The south Borrow Area is bordered on the west by the western CAMU boundary along Eastgate Road, on the north by the Western Ditch, on the east by vacant land, and to the south by southern CAMU boundary. The south Borrow Area is shown on Figure 1.

As shown in Figure 1, the two areas are bisected by the known contaminated area of the previous Western Ditch, which will not be used as the source of any of the borrow materials. Even though there is no evidence of disposal of any waste materials in the proposed Borrow Area, because the area, in general, lies in the midst of other waste disposal areas, it is possible that some surface contamination due to water run-off and airborne deposition may have occurred. Historically, there have been drainage channels in the Borrow Area created by storm water runoff from adjoining CAMU and plant areas. It is possible that the soil in the Borrow Area has been impacted by runoff from neighboring sites.

Groundwater underlying the Site is known to be contaminated. As discussed in Section 2.1 below, exposure pathways associated with groundwater will not be evaluated in the HHRA. Excavations within the Borrow Area will stop prior to reaching groundwater. A full discussion on groundwater quality will be provided in the conceptual site model (CSM) being prepared for the CAMU. The objective of the various investigations and assessments within the Borrow Area were to demonstrate to NDEP that it is acceptable to use soil within this area as off-site fill material. Because locations for placement of Borrow Area soil as off-site fill material have not been determined for certain, groundwater quality at these locations is unknown. It is expected that most, if not all of the Borrow materials will be used in the BMI industrial complex, including for CAMU construction. Potential Borrow Area material use sites within the BMI industrial complex are shown on Figure 2.

1.2 Excavation and Processing of Borrow Area Material

Excavation and processing of Borrow Area material will require activity both in the two portions (Northern and Southern) of the Area and in the processing yard adjacent to the Area. ~~These~~ ~~v~~Various grades of materials will then be used on and off-site depending on customer needs.

In each of the two portions (Northern and Southern), material will be mass-graded and gathered using a bull dozier and belly scraper in tandem. The dozier will cut or rake the material, creating a soft bed of dirt that can be easily gathered by the belly scraper. Once the material is gathered by the scraper, it will be transported to a central location along the boundary between the Area and the processing center. There, the material will be dumped into a pile to be located into the material crusher. A front loader will place the material on a crusher conveyor belt to be dumped in the actual crusher.

As the material is processed it will be separated into two piles. The first pile is Type II aggregate material. Type II aggregate is a granular, structure material used to construct building pads and roadway beds. This material is of high value and is structural in nature. The second pile is reject sand. This is material that is too small to be included in the Type II material. This material has a smaller granular consistency and is used at bedding material for pipeline construction and in landscape applications. Rejected sand will be stockpiled for use in CAMU construction or in off-site uses such as pipeline bed or landscape applications. Should rejected sand be needed for off-site uses, its use will be subject to the same constraints as Type II material.

The definition of Type II is as follows (Ref: Section 704.03.04, found at http://www.rtcsouthernnevada.com/streets/streets_specsindex.htm). Type II can consist of a distribution of sizes, within acceptable ranges as indicated below. For example, Type II materials can contain materials that pass sieve size No. 16 but only as long as such materials do not comprise less than 15% or more than 40% of the material.

Sieve Sizes	Nom. Sieve Opening (mm)	% of Dry Weight Passing Sieve
1”	25.4	100
¾”	6.35	90-100
No. 4	4.76	35-65
No. 16	1.19	15-40
No. 200	0.074 (74 microns)	2-10

2 CONCEPTUAL SITE MODEL AND SUMMARY OF DATA USABILITY EVALUATION

2.1 CONCEPTUAL SITE MODEL

The CSM is a tool used in risk assessment to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the Site, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining data quality objectives and developing exposure scenarios.

The HHRA will evaluate both current and potential future uses of Borrow Area soils. Currently, the Site is undeveloped. Current and future receptors that may access the property include construction workers involved in the excavation of Borrow Area soil and trespassers.[1] Once Borrow Area soil is excavated and after placement as off-site fill material, potential future receptors would be maintenance workers who may be involved in digging or trenching activities in locations where such soils may have been placed. One of the constraints on the future use of Borrow Area soil is that such soils cannot be placed in environmentally sensitive areas, nor be exposed to ambient conditions (see Section 2.1.2). In addition, the Borrow Area itself is within the CAMU boundary. No viable habitat is present in the Borrow Area based on field observations. The area (except for the intervening portion of the Western Ditch) has already been graded in anticipation of gravel mining. The Western Ditch contains sparse vegetation and no discernable habitat. Thus, current and future ecological impacts at the Borrow Area will not be assessed in the HHRA.

The potentially exposed populations and their potential routes of exposure to on-site soil and off-site fill material are presented in Figure ~~2~~ 3 and summarized below.

2.1.1 Potential Impacts to Groundwater

~~Preliminary impacts~~ Impacts to groundwater considering the use of Borrow Area soil as off-site fill material ~~have been evaluated. The evaluation was~~ will be conducted using the VLEACH vertical migration model and site-specific soil analytical results. The VLEACH modeling will be ~~updated based on~~ conducted for the chemicals of potential concern (COPCs) identified in the HHRA.

In order to evaluate heterogeneous soil layers using VLEACH, multiple iterations of VLEACH will be performed, where the output of one run would be used as the input into another run. VLEACH would be run separately for each of the distinctly different soil layers (*e.g.* Borrow material and underlying native soil). For each VLEACH run the user is allowed to input an initial recharge water concentration that comes in the top of the soil layer. At the end of a run, VLEACH provides the concentration in the bottom soil layer and the recharge (or soil moisture)

[1] Trespassers are assumed to be teenagers from 13 to 19 years of age. Trespasser exposure parameters reflect this age range (see Section 5.1.1).

leaving the bottom of the soil layers. Hence from the first VLEACH run for the upper Borrow material the output of soil moisture concentration at the bottom of this soil layer can be used as the input concentration of recharge for the VLEACH evaluation of the subsequent native soil layer below. Likewise the estimated contaminant soil concentration at the bottom of the Borrow material will be used as the initial soil concentration for the upper cell of the underlying native material VLEACH run. Although the use of the model in the fashion is not explicitly mentioned in the VLEACH manual (Model Version 2.2a, USEPA, 1997a), staff at the USEPA Robert S. Kerr Environmental Research Laboratory, Center for Subsurface Modeling Support in Ada, Oklahoma have indicated that this is an appropriate use of the model to account for heterogeneous soil layers.[2]

~~Initial~~ VLEACH model input values are presented in Table 1. ~~Given that the~~ The intent of this evaluation is to predict impacts to groundwater considering the use of Borrow Area soils as off-site fill material. C~~c~~onstraints on the placement of the soil as fill material will ensure~~such~~ that impacts to groundwater will not occur, and therefore exposure pathways associated with groundwater will not be evaluated in the HHRA.

~~2.1.1~~2.1.2 Inter-Media Transfers

Exposure to Site chemicals may be direct, as in the case of impacted soil, or indirect following inter-media transfers. These transfers can be primary or secondary and impacted soil is the initial source. For example, upward migration of volatile organic compounds (VOCs) from impacted subsurface soil into ambient air thereby reaching a point of human inhalation represents a primary transfer.

These inter-media transfers represent the potential migration pathways that may transport one or more chemicals to an area away from the Site where a human receptor could be exposed. Discussions of each of the identified potential transfer pathways are presented below. Figure ~~2~~ 3 presents a conceptualized diagram of the inter-media transfers and fate and transport modeling for the HHRA.

Four initial transfer pathways for which chemicals can migrate from impacted soil to other media have been identified. The first of these pathways is volatilization from soil and upward migration

[2] Personal communications between Ken Kiefer (MWH) and Robert Earle (USEPA), September 27, 2006.

from soil into ambient air. The second primary transfer pathway is via fugitive dust emissions into ambient air. The third primary transfer pathway is downward migration of chemicals from soil to groundwater. However, as discussed above, this pathway ~~has been~~ will be evaluated elsewhere as a constraint to soil placement. Finally, chemicals in soil can be transferred to plants grown in Borrow Area soil via uptake through the roots. The plant uptake pathway is typically evaluated for residential receptors; however, as discussed in Section 2.1.2 below, because the Borrow Area soil will not be used as fill material for residential development, this pathway will not be evaluated in the HHRA.

~~2.1.2~~2.1.3 Potential Human Exposure Scenarios

The following section summarizes Borrow Area soil exposures and the potential human exposure scenarios. For a complete exposure pathway to exist, each of the following elements must be present (USEPA 1989):

- A source and mechanism for chemical release;
- An environmental transport medium (*i.e.*, air, soil);
- A point of potential human contact with the medium; and
- A route of exposure (*e.g.*, inhalation, ingestion, dermal contact).

The Borrow Area soil is proposed for use as fill material for various construction projects. Any such project will involve limited or no post-construction exposures to the Borrow Area soil. The constraints placed on the use of Borrow Area soil as fill material are: (1) the materials will be used in non-residential areas; (2) the placement of soils will be such that there are no exposure pathways for receptors; (3) a minimum soil column height will be maintained between where these soils are placed and the local groundwater such that impacts to groundwater demonstrated via the leaching evaluation are negligible; (4) to the extent possible, these materials will be placed in significant quantities (approximately 50,000 yards) at each location (DBS&A 2006). An additional constraint on the use of Borrow Area soil as fill material is that it will not be placed in environmentally sensitive areas.[3] Therefore, the following presents the primary

[3] These areas may include wetlands, National and State parks, critical habitats for endangered or threatened species, wilderness and natural resource areas, marine sanctuaries and estuarine reserves, conservation areas, preserves, wildlife areas, wildlife refuges, wild and scenic rivers, recreational areas, national forests, Federal and State lands that are research national areas, heritage program areas, land trust areas, and historical and archaeological sites and parks. These areas may also include unique habitats such as aquaculture sites and agricultural surface water intakes, bird nesting areas, critical biological resource areas, designated migratory routes, designated seasonal habitats, State designated Natural Areas, State designated areas for protection or maintenance of aquatic life, and particular areas, relatively small in size, important to maintenance of unique biotic communities.

exposure pathways for each of the potential receptors to Borrow Area soil. These populations and complete/potentially complete exposure pathways for each of the receptors will be evaluated in the HHRA.

- Construction workers (on-site soil/off-site fill material)
  - incidental soil ingestion*
  - external exposure from soil[†]
  - dermal contact with soil
  - outdoor inhalation of dust*[‡]
  - outdoor inhalation of VOCs from soil

- Trespassers (on-site soil)
  - incidental soil ingestion*
  - external exposure from soil[†]
  - dermal contact with soil
  - outdoor inhalation of dust*[‡]
  - outdoor inhalation of VOCs from soil

- Outdoor maintenance workers (off-site fill material)
  - incidental soil ingestion*
  - external exposure from soil[†]
  - dermal contact with soil
  - outdoor inhalation of dust*[‡]
  - outdoor inhalation of VOCs from soil

*Includes radionuclide exposures.
[†]Only radionuclide exposures.
[‡]Includes asbestos exposures.

As indicated above and in Figure ~~2~~3, outdoor maintenance workers, construction workers, and trespassers could be exposed to chemicals in soil through skin contact, inhalation of VOCs in outdoor air, inhalation of chemicals absorbed to fugitive dust, or incidental ingestion of soil when soiled hands or objects are placed in or near the mouth. For radionuclides, external radiation is also a potential soil-related exposure pathway for all receptors. For asbestos, inhalation of fugitive dust is considered the only potential soil-related exposure pathway for all receptors. Risks to potential nearby, off-site receptors that may be impacted during mining and placement activities will be addressed qualitatively in the uncertainty analysis section of the HHRA based on the risk characterization for the on-site receptors.

2.2 SUMMARY OF DATA USABILITY EVALUATION

This section describes the procedures that will be used to evaluate the acceptability of data for use in the HHRA. Overall, the quality of sample results is a function of proper sample management. Management of samples begins at the time of collection and continues throughout the analysis process. The collection of environmental data in 2006 followed the quality assurance/quality control (QA/QC) procedures identified in the Quality Assurance Project Plan (QAPP; BRC and MWH 2006a)[4] prepared for the BRC project, as well as the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006). Standard operating procedures (SOPs) that are wholly consistent with the risk assessment were followed to ensure that samples were collected and managed properly and consistently and to optimize the likelihood that the resultant data are valid and representative. Field methods are discussed in the ~~draft~~ field SOPs (BRC and MWH 2006b~~, in preparation~~), the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006), and adhere to practices consistent with the policies of the NDEP.

A QA/QC review of the analytical results will be conducted prior to conducting the HHRA. The analytical data will be reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA 1992a) and USEPA (1989).

2.2.1 Borrow Area HHRA Datasets

A number of investigations have been performed within the Borrow Area since 2000. These include:

- 2000 Environmental Assessment by Parsons Engineering Science, Inc. (Parsons 2000) (Dataset 10);
- 2003 Limited Environmental Phase II Investigation by Geotechnical & Environmental Services, Inc. (GES 2003a,b) (Datasets 26a and 26b);
- 2003 Asbestos Investigation by MWH and Aeolus Inc. (Aeolus 2003); and

[4] Both the QAPP and SOPs were under review and not yet approved by NDEP at the time of the 2006 Borrow Area sample collection.

- 2006 Soil Investigation by BRC (Dataset 36).

Data from these investigations included in the project database are:

- Borings B-1, B-4, B-5, B-8, B-10, and B-12 from the 2000 Parsons environmental assessment;
- Borings B-13, B-14, B-15, and B-16 from the 2003 GES investigation;
- Borings EB-1 through EB-8, B-5, B-10, and PEB-9 through PEB-18 from the 2003 GES investigations;
- Asbestos samples BEC-1Sb, BEC2Sa through BEC5Sa, and BEC1Da though BEC5Da from the 2003 MWH and Aeolus investigation; and
- Borings BP-01 through BP-10 from the 2006 BRC investigation.

All valid data from these investigations will be included in the HHRA. One exception to this is data from sample PEB-10 from the 2003 GES investigation since soils in the vicinity of this sample location will not be used as Borrow Area fill material. Further elimination of any other data will only occur following discussions with and concurrence from NDEP. These datasets do not include several chemicals that are on the project site-related chemicals list. A discussion of those chemicals that are on the site-related chemicals list but that were not analyzed for will be presented in the uncertainty section of the HHRA report. Data validation reports for all of the datasets that will be used in the risk assessment have been submitted and approved by the NDEP.~~The final soil database, data validation, and data usability evaluation will be submitted to NDEP for approval prior to initiation of the risk assessment.~~

2.2.2 Overview of the Data Evaluation Process

The primary objective of the data review and usability evaluation is to identify appropriate data for use in the HHRA. The analytical data are reviewed for applicability and usability following procedures in USEPA's (1992a) *Guidance for Data Usability in Risk Assessment (Part A)* and USEPA's (1989) *Risk Assessment Guidance for Superfund (RAGS)*. According to USEPA's *Data Usability Guidance*, there are six principal evaluation criteria by which data are judged for usability in risk assessment. These six criteria are:

- Availability of information associated with Site data;

- Documentation;

- Data sources;
- Analytical methods and detection limits;
- Data review; and
- Data quality indicators (DQIs), including precision, accuracy, representativeness, comparability, and completeness (PARCC).

A summary of these six criteria for determining data usability in the HHRA is described in this section.

2.2.3 Criterion I – Availability of Information Associated with Site Data

The usability analysis of the site characterization data requires the availability of sufficient data for review. The required information is available from documentation associated with the Site data and data collection efforts.

2.2.4 Criterion II – Documentation Review

The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available documentation. For the purposes of this data usability analysis, the chain-of-custody forms prepared in the field will be reviewed and compared to the analytical data results provided by the laboratory to ensure completeness of the data set. Based on the documentation review, all samples analyzed by the laboratory will be correlated to the correct geographic location at the Site. Field procedures that will be verified include documentation of sample times, dates and locations, other sample specific information such as depth below ground surface (bgs) will be reviewed.

The analytical data will be reported in a format that provides adequate information for evaluation, including appropriate QC measures and acceptance criteria. Each laboratory report will describe the analytical method used, provide results on a sample by sample basis along with sample specific detection limits, and provide the results of appropriate QC samples such as laboratory control spike samples, sample surrogates and internal standards (organic analyses only), and matrix spike samples. All laboratory reports, except for asbestos,[5] will provide the

[5] At the time of analyses, t~~T~~here were~~are~~ no~~t any~~ Nevada-certified laboratories for providing asbestos data that are useful for risk assessment purposes. The recommended method was~~is only~~ performed by EMS Laboratory in

documentation required by USEPA's Contract Laboratory Program (USEPA 2000a, 2005a,b,c). This documentation includes chain of custody records, calibration data, QC results for blanks, duplicates, and spike samples from the field and laboratory, and all supporting raw data generated during sample analysis. Reported sample analysis results will be imported into the project database.

2.2.5 Criterion III –Data Sources

The review of data sources is performed to determine whether the analytical techniques used in the site characterization process are appropriate to identify the COPCs in the HHRA. The site data collection activities have been developed to characterize a broad spectrum of chemicals potentially present on the Site. Laboratory analyses for the most recent soil investigation are identified in the *Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas* (DBS&A 2006) and Table 2.

The State of Nevada is in the process of certifying the laboratories used to generate the analytical data. As such, standards of practice in these laboratories follow the quality program developed by the Nevada Revised Statutes (NRS) and are within the guidelines of the analytical methodologies established by the USEPA.

2.2.6 Criterion IV – Analytical Methods and Detection Limits

In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the analytical methods appropriately identify COPCs and whether the detection limits are low enough to allow adequate characterization of risks. At a minimum, this data usability criterion can typically be met by using standard USEPA and U.S. Department of Energy (DOE) analytical methods to analyze samples collected at the Site. USEPA and USDOE methods will be used in conducting the laboratory analysis of samples and are considered the most appropriate method for the respective constituent class.

For the analytical data, the associated reference method is provided in the following guidelines:

- USEPA (2000a) *Contract Laboratory Program Statement of Work for Low Concentration Organic Analysis*;

Pasadena, California. This laboratory is not certified in the State of Nevada, but has California and national accreditation for asbestos analysis.

- USEPA (2005a) *Contract Laboratory Program Statement of Work for Organic Analysis*;
- USEPA (2005b) *Contract Laboratory Program Statement of Work for Inorganic Analysis*;
- USEPA (2005c) *Contract Laboratory Program Statement of Work for Chlorinated Dioxins and Furans Analysis*;
- USEPA (1996a) *Test Methods for Evaluation Solid Wastes, SW-846 Third Edition;*
- USDOE (1997) *Procedures Manual of the Environmental Measurements Laboratory, HASL-300*; and
- Berman and Kolk (2000) *Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material*.

Laboratory reporting limits are based on those outlined in the reference method and the sampling and analysis plan. In accordance with respective laboratory SOPs, the analytical processes include performing instrument calibration, laboratory method blanks, and other verification standards used to ensure QC during the analyses of collected samples. An evaluation of detection limits will be performed using appropriate risk-based screening levels identified in the QAPP (BRC and MWH 2006a).

2.2.7 Criterion V – Data Review

The data review portion of the data usability process focuses primarily of the quality of the analytical data that will be received from the laboratory. A Data Validation Summary Report will be prepared for all data collection efforts. Any analytical errors and/or limitations in the data will be addressed and an explanation for data qualification will be provided in respective data tables.

2.2.8 Criterion VI – Data Quality Indicators

DQIs are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for this project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and the HHRA. The DQIs include PARCC. The QAPP (BRC and MWH 2006a) provides the definitions and specific criteria for assessing DQIs using field and laboratory QC samples and is the basis for determining the overall quality of the data set. Data validation activities include the evaluation of PARCC parameters, and all data not meeting the established PARCC criteria will be qualified during the validation process using the guidelines presented in the National Functional Guidelines for Laboratory Data Review, Organics and Inorganics and Dioxin/Furans (USEPA 1999, 2001a, 2004a, 2005d).

For some analytical results, quality criteria will not be met and various data qualifiers will be added to indicate limitations and/or bias in the data. The definitions for the data qualifiers, or data validation flags, used during validation are those defined in USEPA guidelines (USEPA 1999, 2001a, 2004a, 2005d). Data validation flags indicate when results are considered non-detect (U), estimated (J), or rejected (R). Sample results may be rejected based on findings of serious deficiencies in the ability to properly collect or analyze the sample and meet QC criteria. Only rejected data will be considered unusable for decision-making purposes and rejected analytical results will not be used in the HHRA. Sample results qualified as estimated may be affected by special circumstances and are likely to be quantitatively biased to some degree; estimated analytical results will be used in the HHRA. Data qualified as non-detect represents an analyte or compound that is not detected above the sample quantitative limit and such data will be used in the HHRA. These data usability decisions follow the guidelines provided in USEPA's (1992a) *Guidance for Data Usability in Risk Assessment – Part A.*

2.2.9 Data Adequacy

The concept of data adequacy incorporates: (i) an analytical program that seeks to quantify all relevant Site chemicals that have the potential to affect risk calculations, and (ii) a spatial density of sampling points that provides confidence that the Site has been sufficiently characterized. The risk assessment analytical program for the Site represents a broad suite of analyses that cover all chemicals that might be conceivably expected to be present at elevated levels at the Site as a result of historical operations on the Site or adjacent to the Site.

An evaluation of the adequacy of the sampling for use in risk assessment will be presented in the HHRA report. The evaluation may incorporate the results from three analyses. The first qualitatively evaluates whether the sample collection appears to be adequately representative in relation to the CSM. The second analysis addresses data quality using traditional classical statistics-based process. The third analysis presents a probabilistic analysis of the data.

3 SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR HUMAN HEALTH RISK ASSESSMENT

The broad suite of analytes presented in the project analyte list (Table 2) is considered to be the initial list of potential COPCs at the Site, based on site characterization conducted to date. However, in order to ensure that the HHRA focuses on those substances that contribute the greatest to the overall risk (USEPA 1989); two procedures will be used to identify the COPCs for quantitative evaluation in the HHRA:

- Identification of chemicals with detected levels which are greater than background concentrations (where applicable), and
- Identification of chemicals that are frequently detected at the Site.

As to the latter, chemicals that are infrequently detected within an area will be discussed on a case-by-case basis with NDEP. Consistent with USEPA guidance (1989), compounds reliably associated with Site activities based on historical information will not be eliminated from the HHRA, even if the results of the procedures given in this section indicate that such elimination is possible. The procedure for evaluating COPCs relative to background conditions is presented below.

3.1 EVALUATION OF SITE CONCENTRATIONS RELATIVE TO BACKGROUND CONDITIONS

USEPA (1989, 2002a,b) guidance allows for the elimination of chemicals from further quantitative evaluation if detected levels are not elevated above naturally occurring levels. Typically for purposes of selecting COPCs for risk assessment, COPCs are chemicals that are shown to be elevated above naturally occurring levels based on statistical analyses. For the purpose of selecting COPCs for the HHRA, appropriate statistical methods will be applied for the comparison with background data. When the results of the statistical analyses indicate that a particular chemical is within background levels, then the chemical will not be identified as a COPC and will not be quantitatively evaluated in the HHRA. That is, a chemical is selected as a COPC based on background conditions if it is determined to be above background levels in any individual background comparison test. A chemical will be excluded as a COPC only if it is determined to be at or below background levels in all statistical comparison tests. The chemical will, however, be addressed qualitatively in the uncertainty analysis section of the HHRA report (USEPA, 2002a). Also consistent with USEPA guidance (2002a), for chemicals that exceed their respective background levels, risks will be calculated considering both background and site-related risks.

Background concentrations of metals and radionuclides considered representative of the Site soils will be evaluated. The comparison of site-related soil concentrations to background levels will be conducted using the ~~existing, provisional~~ soils background data set presented in the draft *Background Soil Summary Report, BMI Complex and Common Area Vicinity*~~Environ~~ (BRC/TIMET ~~2003~~2006, currently in revision). ~~The~~ This soils background data set includes both the Environ (2003) data set and the BRC/TIMET data set ~~will be used until a subsequent background data set, based on samples~~ collected ~~by BRC~~ in 2005. This combined background data set is still draft and has not yet been ~~is~~ approved by NDEP.

Background comparisons will be performed using the Quantile test, Slippage test, the *t*-test, and the Wilcoxon Rank Sum test with Gehan modification. The Quantile test, Slippage test, and Wilcoxon Rank Sum test are non-parametric. That is, the tests are distribution free, thus an assumption of whether the data are normally or lognormally distributed is not necessary. The computer statistical software program GISdT® (Neptune and Company 2006), will be used to perform all statistical comparisons, with a decision error of alpha = 0.025. An alpha = 0.025 is adequate to identify differences between the two datasets since multiple statistical tests are proposed (Black 2006).

The Wilcoxon Rank Sum test performs a test for a difference between two population measures of center. This is a non-parametric method that relies on the relative rankings of data values and the measure of center is quantified by the sum of the ranks in both Site and background data. Knowledge of the precise form of the population distributions is not necessary. The Wilcoxon Rank Sum test has less power than the two-sample t-test when the data are in fact normally distributed; however the assumptions are not as restrictive. The GISdT® version of the Wilcoxon Rank Sum test uses the Mantel approach which is equivalent to using the Gehan ranking system.

The Quantile test addresses tail effects which are not addressed in the Wilcoxon rank-sum test. The Quantile test looks for differences in the right tails (upper-end of the data set) rather than central tendency like the Wilcoxon rank-sum test. The Quantile test will be performed using a defined quantile = 0.80.

The Slippage test evaluates whether there are an unreasonable number of site data points that exceed the maximum background value.

Typically an alpha = 0.05 is used to evaluate a statistically significant result. Since several tests will be conducted, a lower alpha is selected. As more tests are performed, it is more likely that a statistically significant result will be obtained purely by chance. Given the use of the multiple statistical tests, an alpha = 0.025 is selected as a reasonable significance level for the COPC selection. Any chemical that resulted in a p value less than 0.025 in one of the four tests will be retained as a COPC. Additionally, these tests are set up with one-sided hypotheses. Consequently, not only are differences between the two samples able to be detected, a directional determination can be made as well (*e.g.*, Site is greater than background).

Cumulative probability plots and side-by-side box-and-whisker plots will also be prepared to evaluate whether the Site data and background data are representative of a single population. These plots will not necessarily be used in the selection of COPCs, but will be presented for qualitative purposes. These plots give a visual indication of the similarities between the Site and background data sets. A determination to eliminate a chemical as a COPC on the basis of these visual indications will be made on a case-by-case basis with NDEP.

3.2 Further Selection of Chemicals of Potential Concern

Initially, as discussed above, the broad-suite analytes are considered to be potential COPCs at the Site. From this list, a preliminary list of COPCs will be derived for purposes of risk assessment that includes chemicals that are:

- Positively identified in at least one sample in a given medium, including: (1) chemicals with no qualifiers attached (excluding non-detect results with unusually high detection limits, if warranted), and (2) chemicals with qualifiers attached that indicate known identities but estimated concentrations (*e.g.*, J-qualified data);

- Detected at levels significantly elevated above levels of the same chemicals detected in associated blank samples (this protocol includes an analyte if it is known to be site-related and its concentration is greater than five times the maximum amount detected in any blank; if the chemical is a common laboratory contaminant [as defined by USEPA 1989], it is included only if its concentration is greater than 10 times the maximum amount detected in any blank);

- Detected at levels significantly elevated above naturally-occurring levels of the same chemicals;

- Tentatively identified but presumed to be present because of association with the Site based on historical information; and

- Transformation (*e.g.*, degradation) products of chemicals demonstrated to be present.

In deriving the preliminary list of COPCs, the following criteria established by USEPA (1989) will also be considered:

Historical Information – Examine historical information on the Site. Chemicals likely to be associated with Site activities, based on historical information, will not be eliminated, even if the results of other "COPC reduction" steps indicate that such elimination is warranted.

Concentration and Toxicity - Aspects of concentration and toxicity will be considered prior to eliminating a chemical as a COPC. For example, weight-of-evidence for human toxicity will be considered in conjunction with Site exposure concentrations. Thus, Class A carcinogens will be retained as COPCs.

Consistent with Agency for Toxic Substances and Disease Registry (ATSDR) guidance (De Rosa *et al.*, 1997), if the maximum dioxins/furans toxic equivalency (TEQ) concentration in an exposure area does not exceed the ATSDR screening value of 50 parts per trillion (ppt), dioxins/furans will generally not be retained as COPCs, following consultation with NDEP. This screening value is consistent with a recent review of the scientific evidence for the risks posed by dioxins (Paustenbach *et al.*, 2006).

Availability of Toxicity Criteria – Some chemicals have not been assigned toxicity criteria (*i.e.*, cancer slope factor [CSF] or reference dose [RfD]). Prior to eliminating such chemicals, structure-activity relationship (SAR) analysis and applicability of surrogate toxicity values will be considered.

Mobility, Persistence and Bioaccumulation – Chemicals that are highly mobile, are persistent or tend to bioaccumulate will generally be retained as COPCs.

Special Exposure Routes – For some chemicals under special site-specific scenarios, certain exposure routes need to be considered carefully before eliminating COPCs.

Treatability – Chemicals that are difficult to treat should remain as COPCs because of their importance during the selection of groundwater remedial alternatives if needed.

Documentation of Rationale – Rationale for the exclusion of any chemicals from the risk assessment will be documented in the HHRA report.

Need for Further Reduction of COPCs – The need for further reduction of COPCs will be considered prior to applying reduction criteria. It may be appropriate to narrow the number of COPCs included in fate and transport modeling by grouping COPCs with similar fate and transport properties. That is, the modeled behavior of a given COPC will likely reflect that of other COPCs with similar properties. The selection of appropriate COPCs to be included in fate and transport modeling will be discussed with, and approval sought from, NDEP prior to modeling. A discussion of the COPCs that are not included in fate and transport modeling will be presented in the uncertainty section of the HHRA report.

Approval by NDEP – NDEP approval will be sought prior to the elimination of any potential COPCs from the HHRA.

Frequency of detection (FOD) is another criterion that may warrant COPC reduction. Chemicals exhibiting a low FOD within a specific exposure area generally will not contribute significantly to risk and hazard estimates when hot spots are not present. USEPA (1989) suggests that chemicals with a FOD less than or equal to five percent, with the exception of metals and known human carcinogens, may be considered for elimination. Prior to eliminating a COPC based on the FOD criteria, (1) any elevated detection limits will be addressed, and (2) data distributions within exposure areas will be considered (*e.g.*, potential hot spots will be assessed). Additionally, the detection of the COPC in all sampled media will be considered. For example, USEPA recommends that a chemical infrequently detected in soil should not be eliminated if it is frequently detected in groundwater and exhibits mobility in soil. As stated above, chemicals that are infrequently detected will be addressed on an exposure area-specific basis and will be discussed on a case-by-case basis with NDEP.

3.3 SUMMARY AND PRESENTATION OF CHEMICALS OF POTENTIAL CONCERN

A summary of the site COPC data (*i.e.*, chemical, range of concentration, background levels, FOD, retained/eliminated as COPC, and rationale for elimination) will be presented in table form. Any additional discussion of COPC selection will be made in the text as necessary.

4 DETERMINATION OF REPRESENTATIVE EXPOSURE CONCENTRATIONS

A representative exposure concentration is a COPC-specific and media-specific concentration value used in the dose equation for each receptor and each exposure pathway. As described below, the methods, rationale, and assumptions employed in deriving the representative exposure concentrations will be consistent with USEPA guidance and will reflect site-specific conditions.

4.1 Soil

The HHRA will incorporate representative exposure concentration estimates (*e.g.*, 95 percent upper confidence limit [UCL] on the arithmetic mean [USEPA 1992b, 2002c]) that specifically relate to potential site-specific human exposure conditions. For the 95 percent UCL concentration approach, the 95 percent UCL will be computed in order to represent the area-wide exposure point concentrations. The UCL incorporates the uncertainty of the estimate of the mean and is the value that, with repeated sets of samples, will be greater than the true mean 95 percent of the time. Based on USEPA (1989) guidance, non-detects for COPCs will be assigned a value of one-half the detection limit. Other methods for addressing non-detects may be considered. For radionuclide uncensored data, the actual reported value will be used. Data identified in the data usability evaluation as unusable due to elevated reporting limits will not be used in the calculation of representative exposure concentrations. The formulas for calculating the 95 percent UCL COPC concentration (as the representative exposure concentration) are presented in USEPA (1992b, 2002c). The 95 percent UCL statistical calculations will be performed using the computer statistical software program GISdT® (Neptune and Company 2006).

The 95 percent UCL of the arithmetic mean concentration is used as the average concentration, because it is not possible to know the true mean. The 95 percent UCL, therefore, accounts for uncertainties due to limited sampling data. An estimate of average concentration is used because: carcinogenic and chronic non-carcinogenic toxicity criteria are based on lifetime average exposures; and, average concentration is most representative of the concentration that would be contacted at a site, over time (USEPA 1992b).

Representative exposure concentrations for soil are typically based on the potential exposure depth for each of the receptors. However, given that the HHRA will assess exposures to soil following excavation and use as off-site fill material, it is proposed that a 95 percent UCL be generated for all data collected within the excavation extent and depth. This 95 percent UCL will be used for all potentially exposed receptors. For indirect exposures, this concentration will be used in fate and transport modeling.

4.2 Outdoor Air

Long–term exposure to COPCs bound to dust particles will be evaluated using the USEPA's Particulate Emission Factor (PEF) approach (USEPA 2002d). The PEF relates concentrations of a chemical in soil to the concentration of dust particles in the air. The Q/C (Site-Specific Dispersion Factor [USEPA 2002d]) values in this equation will be for Las Vegas, Nevada

(Appendix D of USEPA 2002d; see Table 2). The USEPA guidance for dust generated by construction activities (USEPA 2002d) will be used for short-term on-site and off-site construction worker exposures. Input soil concentrations for the model will be the 95 percent UCL concentrations as described above. For exposures to VOCs in outdoor air, the USEPA volatilization factor approach will be used (USEPA 2002d). The same volatilization factors will be used for all scenarios. The volatilization factors for the construction worker will not be adjusted to account for soil intrusion activities. Soil intrusion associated with construction activities could results in increased volatilization from the subsurface to outdoor. However, the volatilization factors to be used are conservative and are not likely to underestimate exposures. Fate and transport model input values are presented in Table 3.

5 HUMAN HEALTH RISK ASSESSMENT APPROACH

The following risk assessment approach will be conducted for all COPCs, with the exception of lead. A project-specific cleanup goal of 400 mg/kg has been established for lead during previous meetings with NDEP.

5.1 DETERMINISTIC HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The deterministic risk assessment will follow procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund: Volume I -Human Health Evaluation Manual* (USEPA 1989). Other guidance documents that will be relied on include:

- *Guidelines for Exposure Assessment*. USEPA. 1992c.
- *Exposure Factors Handbook, Volumes I-III*. USEPA 1997b.
- *Soil Screening Guidance: Technical Background Document*. USEPA 1996b.
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. USEPA 2002d.
- *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual*. Supplemental Guidance. USEPA. 1991.
- Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96. NDEP. 1996.

5.1.1 Deterministic Exposure Parameters

The exposure parameters proposed to be used in the deterministic risk assessment are presented in Tables 4 through 6. These conservative default values are primarily based on standard USEPA guidance values. In some instances standard USEPA guidance values are unavailable. This is the case for trespasser exposure frequency and time. In these instances, professional judgment was used to select appropriate exposure factors. For the trespasser exposure frequency and time, it is assumed that a trespasser could access the Site for 50 days per year (or one day per week) and spend four hours on the Site per visit. Exposure parameters that have significant impact on the results will be discussed in the uncertainty section of the HHRA report.

5.1.2 Deterministic Exposure Assessment

Reasonable maximum exposure levels to chemicals will be calculated for each receptor of concern, using the exposure parameters identified in Tables 4 through 6. The methodology used to estimate the average daily dose (ADD) of the chemicals via each of the complete exposure pathways is based on USEPA (1989, 1992c) guidance. For carcinogens, lifetime ADD (LADD) estimates are based on chronic lifetime exposure extrapolated over the estimated average 70-year lifetime (USEPA 1989). This is performed in order to be consistent with CSFs, which are based on chronic lifetime exposures. For non-carcinogens, ADD estimates will be averaged over the estimated exposure period. The generic equation for calculating the ADDs and LADDs is:

$$Dose = \frac{C \times IR \times ED \times EF \times BIO}{BW \times AT \times 365\ d/yr}$$

where:

Dose	=	ADD for non-carcinogens and LADD for carcinogens (in mg/kg-day)
C	=	chemical concentration in the contact medium (mg/kg soil)
IR	=	intake rate (*e.g.*, mg/day soil ingestion and dermal contact; m^3/day for inhalation)
ED	=	exposure duration (years of exposure)
EF	=	exposure frequency (number of days per year)
BW	=	average body weight over the exposure period (kilograms)
BIO	=	relative bioavailability (unitless)
AT	=	averaging time; same as the ED for non-carcinogens and 70 years (average lifetime) for carcinogens

With the exception of arsenic, the relative oral bioavailability (BIO) of all COPCs will be 100 percent. For arsenic, consistent with scientific literature recommendations on arsenic bioavailability (Roberts *et al*. 2001; Ruby *et al*. 1999; USEPA 2001b), an arsenic oral bioavailability of 30 percent will be used. The actual oral bioavailability of arsenic (as well as other metals at the Site, for which an oral bioavailability of 100 percent will be used) is likely to be lower than this value. Chemical-specific dermal absorption values from USEPA guidance (USEPA 2004b [Part E RAGS]) will be used in the HHRA.

Exposure levels of potentially-carcinogenic and non-carcinogenic chemicals will be calculated separately because different exposure assumptions apply (*i.e.*, ADD for non-carcinogens and LADD for carcinogens). Exposure levels will be estimated for each relevant exposure pathway (*i.e.*, soil, air), and for each exposure route (*i.e.*, oral, inhalation, and dermal). Daily doses for the same route of exposure will be summed. The total dose of each chemical is the sum of doses across all applicable exposure routes.

The results of the exposure assessment will be used with information on the toxicity of the COPCs in the risk characterization step of the HHRA to estimate the potential risks to human health posed by exposure to the COPCs. This process is discussed in Section 7.

5.2 RADIONUCLIDE RISK ASSESSMENT METHODOLOGY

Risks associated with radionuclides will be evaluated separately from chemicals. Recently available USEPA risk assessment methodologies for radionuclides will be used (USEPA 2000b). There are several important differences between evaluating risks pertinent to radionuclides and those pertinent to chemicals. These differences include:

- Concentrations are based on units of activity (*e.g.*, pCi) instead of units of mass (*e.g.*, mg) in soil;
- Only the carcinogenic effects of radionuclides due to ionizing radiation are considered. A radionuclide may also have a chemical toxicity (*e.g.* uranium or lead). These risks are addressed separately by using the concentration of mass of chemical in soil, rather than activity; and
- CSFs are based on the total theoretical age-averaged incremental lifetime cancer risk per intake of the radionuclide, or per unit external radiation exposure to gamma-emitting radionuclides. An adult only soil ingestion CSF is available and will be used for all receptors. Except for external CSFs, which are presented as risk/year per pCi/g soil, CSFs for

radionuclides are not expressed as a function of body weight or time as are CSFs for chemicals.

Exposure equations and parameter values used will be the standard deterministic risk assessment exposure parameters based on typical USEPA (2000b, 2006a) default values. The exposure equations are modified to include radionuclide decay as used in USEPA's radionuclide PRG equations (USEPA 2006a). Default parameter values are presented in Tables 4 through 6. These factors will also be used in the calculation of background radionuclide risk levels.

5.3 ASBESTOS RISK ASSESSMENT METHODOLOGY

Although final guidance is unavailable at this time, USEPA recommends that site-specific risk assessments be performed for asbestos (USEPA 2004d). Risks associated with asbestos in soil will be evaluated using the most recent draft methodology proposed by USEPA (2003b). This methodology is an update of the method described in *Methodology for Conducting Risk Assessments at Asbestos Superfund Sites-Part 1: Protocol* and *Part 2: Technical Background Document* (Berman and Crump, 1999a,b). Exposure pathways, equations, and parameters to be used will be those presented in USEPA (2003b). Adjustments for exposure duration and exposure intensity, consistent with the methodology, will be made for each of the receptor populations, based on the respective exposure parameters presented in Tables 4 through 6.

The exposure point concentration for asbestos is based on the pooled analytical sensitivity of the dataset. The pooled analytical sensitivity is calculated as follows:

$$Pooled\ Analytical\ Sensitivity = 1/\left[\sum_i (1/analytical\ sensitivity\ \ for\ trial\ i)\right]$$

Two estimates of the asbestos concentration will be evaluated. The estimate of the mean asbestos concentration is the number of asbestos fibers detected multiplied by the pooled analytical sensitivity. The upper bound estimate is the upper confidence bound of the mean of the assumed underlying Poisson distribution used to model the number of structures found multiplied by the pooled analytical sensitivity. The intent of the risk assessment methodology is to predict the amount of airborne asbestos which can be inhaled by a receptor. In addition, it will be assumed that asbestos only occurs at the soil surface (*i.e.*, upper two inches).

For assessing asbestos risks, Table 8-2 (Based on Optimum Risk Coefficients) of USEPA (2003b) will be used. Population averaged risks will be evaluated based on Eqn. 8-1 of USEPA (2003b). This equation considers male smokers, male non-smokes, female smokers, and female non-smokers. In addition, because both chrysotile and amphibole have been detected in the general area (for example, from the City of Henderson wastewater reclamation facility [WRF] sampling), both could be expected to occur at the Site. Therefore, both amphibole and chrysotile fibers will be conservatively evaluated in the HHRA, regardless as to whether either is detected (as calculated using the 95 percent UCL of the mean of the assumed underlying Poisson distribution).

To interpret measurements of asbestos in soils, it is necessary to establish the relationship between the asbestos concentrations observed in soils and concentrations that will occur in air when such soil is disturbed by natural or anthropogenic forces. This is because asbestos is a hazard when inhaled (see, for example, USEPA 2003b). In fact, the Modified Elutriator Method (Berman and Kolk 2000), which was the method employed to perform the analyses to be used in the HHRA, was designed specifically to facilitate prediction of airborne asbestos exposures based on bulk measurements (see, for example, Berman and Chatfield 1990). The method of sample preparation and analysis for asbestos involves collection of composite samples that are re-suspended and then forced through an airway and filter. Because of this, coupled with the very low response (few detections), there is probably very limited value, if any, to compositing the samples before analysis.

6 TOXICITY ASSESSMENT

This section identifies how toxicity values to be used for the HHRA will be obtained. Toxicity values are published by the USEPA in the on-line Integrated Risk Information System [IRIS]; USEPA 2006b). CSFs are chemical-specific and experimentally derived potency values that are used to calculate the risk of cancer resulting from exposure to potentially carcinogenic chemicals. A higher value implies a more potent carcinogenic potential. RfDs are experimentally derived “no-effect” levels used to quantify the extent of toxic effects other than cancer due to exposure to chemicals. With RfDs, a lower value implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in the USEPA risk assessment guidance documents and databases. Toxicity criteria will not be developed *de novo* by BRC for elements or compounds that do not have criteria published in the above sources. Should COPCs be found which do not have established toxicity criteria; these will be discussed on a case-by-case basis with NDEP and qualitatively addressed in the uncertainty analysis of the HHRA report. Where appropriate, and only as approved by NDEP, non-carcinogenic surrogate RfDs may be applied.

Like any biological reaction, the toxicity of a chemical on humans can be described as a range of possible outcomes (severities and levels that cause an endpoint of concern). Available toxicity values for all Site COPCs to be used in the HHRA will be obtained from the USEPA. The following hierarchy for selecting toxicity criteria will be used (based on USEPA 2003c):

1. IRIS
2. USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs)
3. National Center for Environmental Assessment (NCEA, or other current USEPA sources)
4. Health Effects Assessment Summary Tables (HEAST)
5. USEPA Criteria Documents (*e.g.*, drinking water criteria documents, drinking water Health Advisory summaries, ambient water quality criteria documents, and air quality criteria documents)
6. Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles
7. USEPA's Environmental Criteria and Assessment Office (ECAO)
8. Peer-reviewed scientific literature

For carcinogens, the USEPA weight-of-evidence classification will be identified for each carcinogenic COPC. Available RfDs will be obtained for all COPCs, including carcinogens. A list of COPC-specific non-carcinogenic and carcinogenic toxicity criteria, current at the time of the HHRA, will be submitted to NDEP for approval prior to initiation of the risk assessment. Radionuclides toxicity criteria will be obtained from the USEPA's *Radionuclide Toxicity and Preliminary Remediation Goals for Superfund* (USEPA 2006a). For some radionuclides, two different toxicity criteria are available: for that radionuclide only, and for the radionuclide and associated short-lived radioactive decay products (*i.e.*, those decay products with radioactive half-lives less than or equal to six months). To be conservative, the toxicity criteria that include radioactive decay products will be used, even though toxicity criteria are available for some of their respective radioactive decay products, which are also assessed separately.

Although route-to-route extrapolation is generally inappropriate without adequate toxicological information, in this case route-to-route extrapolation will be applied based on USEPA's approach (USEPA 2004c). The uncertainties associated with this approach will be addressed in the HHRA report. CSFs that account for risks from associated short-lived radioactive decay products (*i.e.*, radon) will be used in the HHRA.

Although USEPA has developed toxicity criteria for the oral and inhalation routes of exposure, it has not developed toxicity criteria for the dermal route of exposure. USEPA has proposed a method for extrapolating oral toxicity criteria to the dermal route in the recently released *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA 2004b). Although a review draft, USEPA stated that the adjustment of the oral toxicity factor for dermal exposures is necessary only when the oral-gastrointestinal absorption efficiency of the chemical of interest is less than 50 percent (due to the variability inherent in absorption studies).

For the dioxins/furans (CDD/CDFs), the USEPA toxicity equivalency procedure, developed to describe the cumulative toxicity of these compounds, will be applied. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the 2,3,7,8 substituted CDD/CDF congeners. TEFs are estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1.0. Calculating the toxic equivalency (TEQ) of a mixture involves multiplying the concentration of individual congeners by their respective TEF. One-half the detection limit will be used for calculating the TEQ for individual congeners that are non-detect in a particular sample. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture. TEFs from USEPA (2000c) will be used in the HHRA.

For carcinogenic polycyclic aromatic hydrocarbons (PAHs), provisional USEPA guidance for estimating cancer risks will be used (USEPA 1993). The procedure uses information from the scientific literature to estimate the carcinogenic potency of several PAHs relative to benzo(a)pyrene. These relative potencies may be used to modify the CSF developed for benzo(a)pyrene for each PAH, or to calculate benzo(a)pyrene equivalent concentrations for each of the PAH's (which would then be used with the benzo(a)pyrene CSF). The former approach will be used in the HHRA. If one carcinogenic PAH is considered a COPC then all seven carcinogenic PAHs will be considered COPCs, regardless of whether or not they were detected at the Site. Although route-to-route extrapolation is inappropriate without adequate toxicological information, route-to-route extrapolation will be applied based on USEPA's approach.

The USEPA has not derived toxicity criteria to evaluate the potential non-cancer health hazards associated with exposure to the carcinogenic PAH COPCs. For the HHRA, a toxicological surrogate (*i.e.*, pyrene) will be used to quantify the potential non-carcinogenic effects of the carcinogenic PAHs. This surrogate was selected from a list of six PAHs for which non-cancer oral toxicity criteria have been assigned by the USEPA based on a careful consideration of their relevant toxicity data, target organ(s), dose-response information, and structure-activity relationships. From the available oral non-cancer toxicity data reported by the USEPA, the most sensitive target organs are the liver, kidney, and blood (hematological effects) (IRIS, USEPA 2006b; ATSDR 1990, 1995; ORNL 1993). For the carcinogenic PAHs, the non-cancer target organs were found to be the same and the reported toxicological thresholds for these effects are generally in the range for those reported for the non-cancer PAHs (ATSDR 1995). Although naphthalene (2-ring structure) has the most stringent oral non-cancer toxicity criterion (0.02 mg/kg day), pyrene (4-ring structure; oral reference dose of 0.03 mg/kg-day) was selected to be the best surrogate due to (1) non-cancer toxicity endpoints are more consistent with those for carcinogenic PAHs and (2) the greater number of rings in the pyrene chemical structure.

7 RISK CHARACTERIZATION

In the last step of a risk assessment, the estimated rate at which a person intakes a COPC is compared with information about the toxicity of that COPC to estimate the potential risks to human health posed by exposure to the COPC. This step is known as risk characterization. In the risk characterization, cancer risks will be evaluated separately from non-cancer adverse health effects. The methods used for assessing cancer risks and non-cancer adverse health effects are discussed below.

7.1 METHODS FOR ASSESSING CANCER RISKS

In the risk characterization, carcinogenic risk will be estimated as the incremental probability of an individual developing cancer over a lifetime as a result of a chemical exposure. Carcinogenic risks will be evaluated by multiplying the estimated average exposure rate (*i.e.*, LADD calculated in the exposure assessment) by the chemical's CSF. The CSF converts estimated daily doses averaged over a lifetime to incremental risk of an individual developing cancer. Theoretical risks associated with low levels of exposure in humans are assumed to be directly related to an observed cancer incidence in animals associated with high levels of exposure. According to USEPA (1989), this approach is appropriate for theoretical upper-bound incremental lifetime cancer risks of less than 1×10^{-2}. The following equations will be used to calculate chemical-specific risks and total risks:

$$Risk = LADD \times CSF$$

where:

LADD	=	lifetime average daily dose (mg/kg-d)
CSF	=	cancer slope factor $(mg/kg\text{-}d)^{-1}$

and

$$Total\ Carcinogenic\ Risk = \Sigma\, Individual\ Risk$$

It will be assumed that cancer risks from various exposure routes are additive. Thus, the result of the assessment is necessarily a high-end estimate of the total carcinogenic risk. High-end carcinogenic risk estimates will be evaluated by NDEP in light of site-specific risk management decision criteria.

7.2 Methods for Assessing Non-Cancer Health Effects

Non-cancer adverse health effects are estimated by comparing the estimated average exposure rate (*i.e.*, ADDs estimated in the exposure assessment) with an exposure level at which no adverse health effects are expected to occur for a long period of exposure (*i.e.*, the RfDs).

ADDs and RfDs are compared by dividing the ADD by the RfD to obtain the ADD:RfD ratio, as follows:

$$Hazard\ Quotient = \frac{ADD}{RfD}$$

where:

ADD	=	average daily dose (mg/kg-d)
RfD	=	reference dose (mg/kg-d)

The ADD-to-RfD ratio is known as a hazard quotient. If a person's average exposure is less than the RfD (*i.e.*, if the hazard quotient is less than 1), the chemical is considered unlikely to pose a significant non-carcinogenic health hazard to individuals under the given exposure conditions. Unlike carcinogenic risk estimates, a hazard quotient is not expressed as a probability. Therefore, while both cancer and non-cancer risk characterizations indicate a relative potential for adverse effects to occur from exposure to a chemical, a non-cancer adverse health effect estimate is not directly comparable with a cancer risk estimate.

If more than one pathway is evaluated, the hazard quotients for each pathway, for all COPCs, will be summed to determine whether exposure to a combination of pathways poses a health concern. This sum of the hazard quotients is known as an HI.

$$Hazard\ Index = \Sigma\, Hazard\ Quotients$$

A total HI that includes all COPCs and all exposure pathways will be presented in the HHRA. The NDEP non-cancer risk management target is an HI value of less than or equal to 1.

For any HI that exceeds 1, the potential for adverse health effects will be further evaluated by considering the target organs upon which each chemical could have an adverse effect. Target organ-specific HIs will be assessed only after approval by NDEP. The target organ specific HIs will be summed for all relevant COPCs. The segregation of HI by target organ is consistent with USEPA guidance for non-carcinogens, including metals (USEPA 1989, 1998, 2001c).

8 UNCERTAINTY ANALYSIS

Consistent with USEPA (1989) guidance, for the deterministic risk assessment, a qualitative discussion of the uncertainties associated with the estimation of risks for the Site will be presented in the HHRA report. The uncertainty analysis will discuss uncertainties associated with each step of the risk assessment, including site characterization data, data usability, selection of COPCs, representative exposure concentrations, fate and transport modeling, exposure assessment, toxicity assessment, and risk characterization. For both non-carcinogens and carcinogens, the relative contribution of specific COPCs and pathways to total risk and HI will be identified.

9 INTERPRETATION OF FINDINGS

The risk characterization results will be presented in tabular format in the HHRA report. Key exposure (*e.g.*, estimated intakes, important modeling assumptions, summary of exposure pathways for each receptor) and toxicity information (*e.g.*, CSFs, RfDs, target organs) will be provided. In addition, the risk characterization results will be placed into proper perspective, including a discussion of the concept of *de minimis* risk. The cancer risk assessment results will be presented for both total cancer risk and background cancer risk estimates, as well as presentation of the percent contribution of the background cancer risk to the total cancer risk. In addition, those COPCs and exposure pathways having the greatest influence on the risk assessment results will be identified. As appropriate, graphical presentation of the results will also be included in the HHRA report.

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TABLE 1
VLEACH MODEL INPUT PARAMETERS
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Case Settings and Initial Conditions Input Parameters	**Units**	**Top Layer 1 (Borrow Materials)**	**Bottom Layer 2 (Native Soils)**
Simulation Timestep	days	365	365
Simulation Length	years	30	30
Simulation Length[a]	days	10,958	10,958
Number of Cells[a]	--	1	10
Recharge Rate[b]	cm/day	0.0139 - 0.0417	0.0139 - 0.0417
Output Timestep[a]	days	365	365
Depth below grade to water table	feet	0[c]	Actual, based on placement location
Fill depth	feet	Actual, based on placement location	NA
Chemical Property Input Parameters	**Units**	**Value**	**Value**
Water solubility	mg/L	chemical-specific values to be obtained from USEPA 2002d.	chemical-specific values to be obtained from USEPA 2002d.
Soil pore water partition coefficient	ml/g		
organic carbon partition coefficient	ml/g		
Henry's Law constant	unitless		
Free air dispersion coefficient	cm^2/sec		
Soil Input Parameters[d]	**Units**	**Value**	**Value**
Bulk density	g/cm^3	material-specific values to be obtained by field measurements.	material-specific values to be obtained by field measurements.
Effective porosity	cm^3/cm^3		
Volumetric water content in vadose zone soils	cm^3/cm^3		
Volumetric air content in vadose zone soils[e]	cm^3/cm^3		
Percent organic carbon	%		

[a]The mass balance will be checked to confirm that the simulation length, timestep and number of cells provide a stable solution.

[b]A sensitivity analysis will be performed using a range of values for this parameter. The range shown is from 2 to 6 inches per year. Four inches per year is equivalent to 100 percent of rainfall. It should be noted that this recharge rate is much higher than the highest recharge rate for Las Vegas, Nevada from USEPA's Composite Model for Leachate Migration with Transformation Products (EPACMTP) Parameters/Data: Background Document (2003a). In addition, the assumption of 100 percent recharge from precipitation is much higher than that calculated in a recent study by UNLV which indicated a recharge rate of approximately 3 percent (James et al. 2006). This also assumes no additional water application to the site/location.

[c] Not necessary for the first (top) Borrow material layer since it is assumed that this material will be placed immediately on top of the native material, and that the concentration at the bottom of this layer will be used as input into next lower native soil layer.

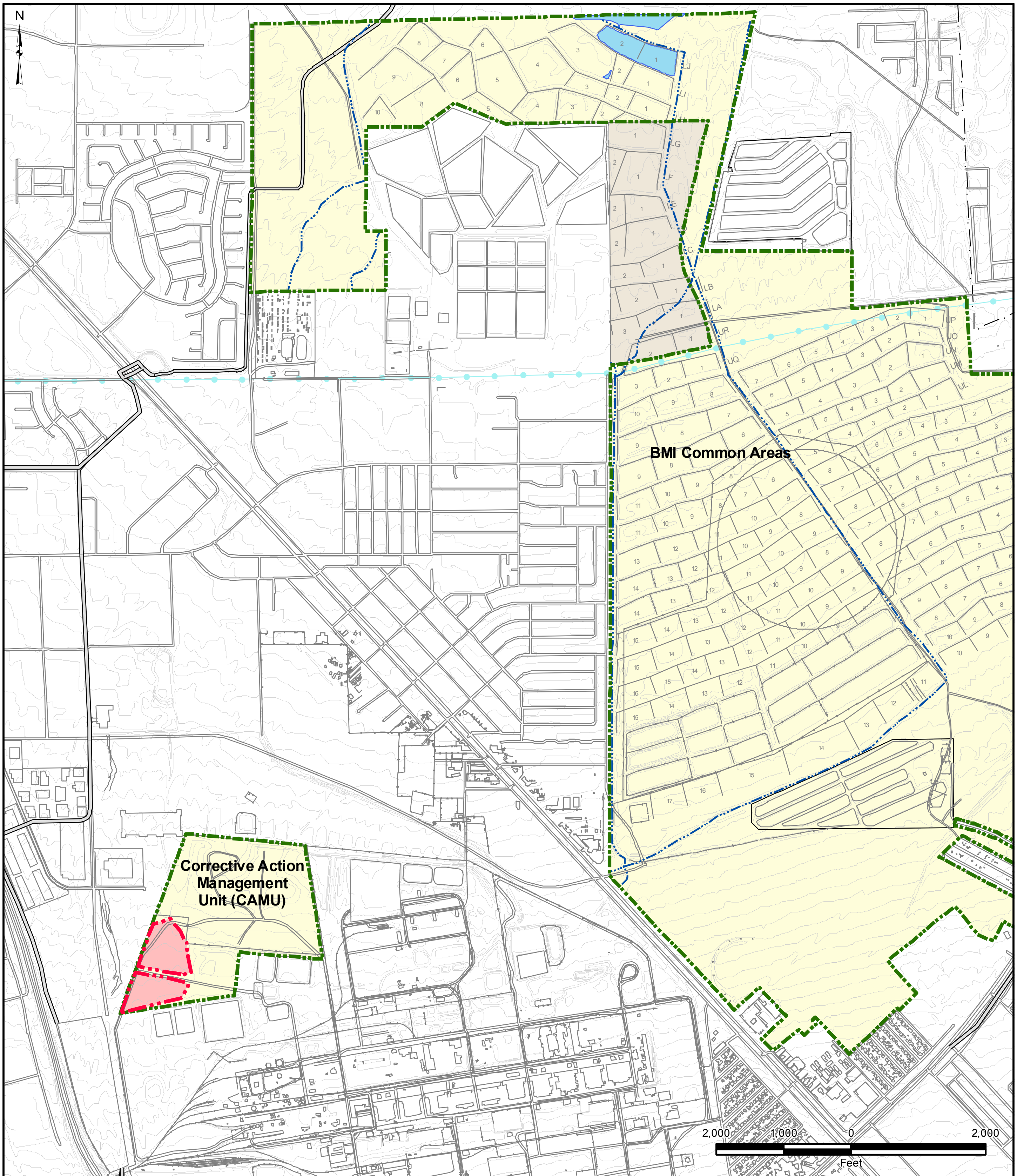
[d]Soil input parameters will be the average of all available site-specific data to be collected from the Borrow Area for each of the different Borrow materials. Laboratory reports for the data, sample locations, data validation, and data usability evaluation for those data, will be provided to NDEP.

[e]~~Values will be obtained from placement location materials tests or be representative of such locations. Initial model runs may use values shown below from the VLEACH manual for a typical sand soil:~~

~~Bulk density~~	~~g/cm^3~~		~~1.65~~
~~Effective porosity~~	~~cm^3/cm^3~~		~~0.35~~
~~Volumetric water content in vadose zone soils~~	~~cm^3/cm^3~~		~~0.045~~
~~Volumetric air content in vadose zone soils[e]~~	~~cm^3/cm^3~~		~~0.31~~
~~Percent organic carbon~~	~~%~~		~~0.71~~

[e]~~Effective~~Total porosity minus volumetric water content in vadose zone soils.

FIGURES



Borrow Area Boundary

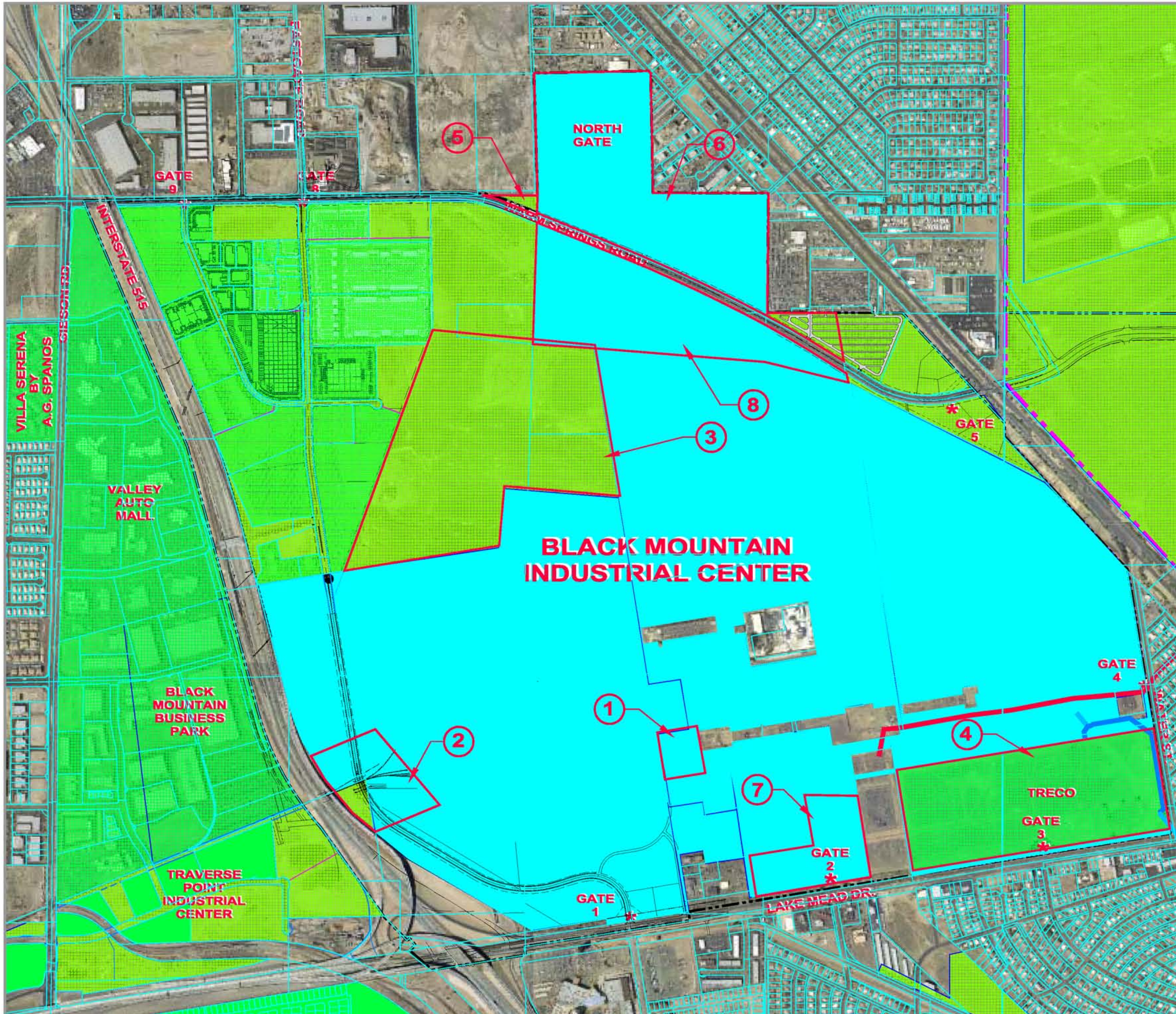
Borrow Area
BMI Complex, Clark County, Nevada

FIGURE 1

BORROW AREA LOCATION

Basic Remediation COMPANY

Prepared by:	Date	JOB No. 1881459
MWH MKJ	03/21/06	FILE: GIS/BRC/BA_FIGURE1.MXD



THE LANDWELL COMPANY

FIGURE 2

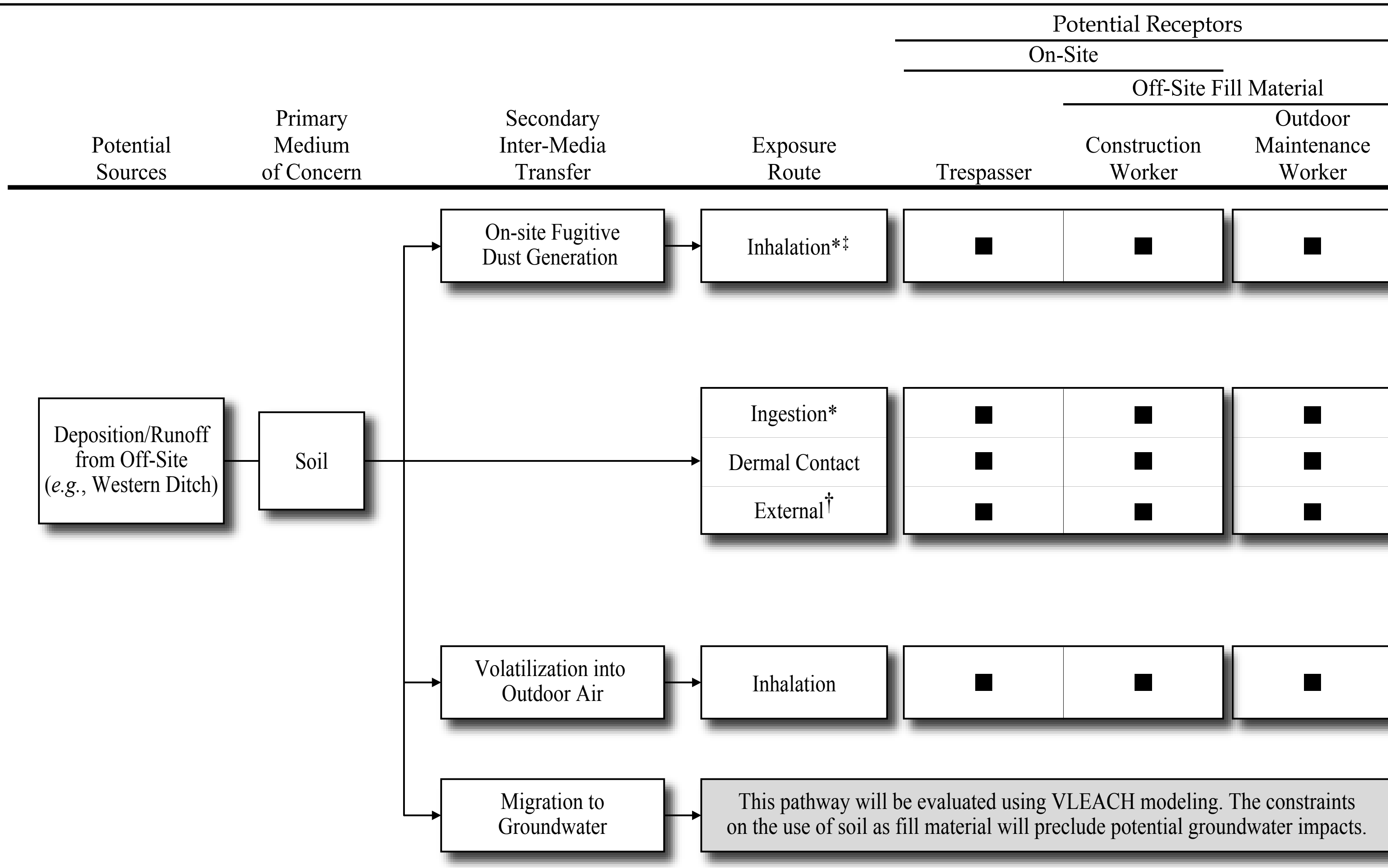
POTENTIAL BORROW AREA MATERIAL USER SITES
(SPRING 2006 AERIALS)

1. 4TH & F STREET
2. EASTGATE RD. CROSSING
3. CAMU CAPPING MAT.
4. TRECO 73 ACRES
5. WARM SPRINGS/BURNS
6. NORTHGATE
7. GATE 2
8. GATE 7

N

1" = 500'

PBS&J



□ - Incomplete or insignificant exposure pathway.

■ - Complete exposure pathway to Borrow Area soil.

*Includes radionuclide exposures.

†Only radionuclide exposures.

‡Includes asbestos exposures.

Notes:

- Construction workers exposures include on-site excavation activities and off-site fill material placement activities.
- Current receptors that may access the property include construction workers and trespassers. Outdoor maintenance workers are assumed to only access the soil following its use as fill material at off-site locations.
- Because the future anticipated use of Borrow Area soil precludes use in residential areas, the risk assessment will not evaluate a hypothetical future residential exposure scenario.
- One of the constraints on the future use of Borrow Area soil is that such soils cannot be placed in environmentally sensitive areas, nor be exposed to ambient conditions (see Section 2.1.2); thus, ecological impacts will not be assessed.
- Risks to potential nearby, off-site receptors that may be impacted during mining and placement activities will be addressed qualitatively in the uncertainty analysis section of the HHRA based on the risk characterization for the on-site receptors.

Borrow Area
BMI Complex, Clark County, Nevada

FIGURE 3

CONCEPTUAL SITE MODEL DIAGRAM FOR POTENTIAL SOIL EXPOSURES

Basic Remediation COMPANY

Prepared by: MWH MKJ | Date 10/02/06 | JOB No. 1881459 FILE: GIS/BRC/BA_FIGURE3.AI

TABLES

TABLE 1
VLEACH MODEL INPUT PARAMETERS
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Case Settings and Initial Conditions Input Parameters	Units	Top Layer 1 (Borrow Materials)	Bottom Layer 2 (Native Soils)
Simulation Timestep	days	365	365
Simulation Length	years	30	30
Simulation Length[a]	days	10,958	10,958
Number of Cells[a]	--	1	10
Recharge Rate[b]	cm/day	0.0139 - 0.0417	0.0139 - 0.0417
Output Timestep[a]	days	365	365
Depth below grade to water table	feet	0[c]	Actual, based on placement location
Fill depth	feet	Actual, based on placement location	NA
Chemical Property Input Parameters	**Units**	**Value**	**Value**
Water solubility	mg/L	chemical-specific values to be obtained from USEPA 2002d.	chemical-specific values to be obtained from USEPA 2002d.
Soil pore water partition coefficient	ml/g		
organic carbon partition coefficient	ml/g		
Henry's Law constant	unitless		
Free air dispersion coefficient	cm^2/sec		
Soil Input Parameters[d]	**Units**	**Value**	**Value**
Bulk density	g/cm^3	material-specific values to be obtained by field measurements.	material-specific values to be obtained by field measurements.
Effective porosity	cm^3/cm^3		
Volumetric water content in vadose zone soils	cm^3/cm^3		
Volumetric air content in vadose zone soils[e]	cm^3/cm^3		
Percent organic carbon	%		

[a]The mass balance will be checked to confirm that the simulation length, timestep and number of cells provide a stable solution.

[b]A sensitivity analysis will be performed using a range of values for this parameter. The range shown is from 2 to 6 inches per year. Four inches per year is equivalent to 100 percent of rainfall. It should be noted that this recharge rate is much higher than the highest recharge rate for Las Vegas, Nevada from USEPA's Composite Model for Leachate Migration with Transformation Products (EPACMTP) Parameters/Data: Background Document (2003a). In addition, the assumption of 100 percent recharge from precipitation is much higher than that calculated in a recent study by UNLV which indicated a recharge rate of approximately 3 percent (James et al. 2006). This also assumes no additional water application to the site/location.

[c] Not necessary for the first (top) Borrow material layer since it is assumed that this material will be placed immediately on top of the native material, and that the concentration at the bottom of this layer will be used as input into next lower native soil layer.

[d]Soil input parameters will be the average of all available site-specific data to be collected from the Borrow Area for each of the different Borrow materials. Laboratory reports for the data, sample locations, data validation, and data usability evaluation for those data, will be provided to NDEP.

[e]Total porosity minus volumetric water content in vadose zone soils.

TABLE 2
2006 BORROW AREA INVESTIGATION PROJECT LIST OF ANALYTES
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Chemical Group	Analytical Method	CAS Number	Compound List
Ions	EPA 314.0	14797-73-0	Perchlorate
Polychlorinated Dibenzodioxins/ Dibenzofurans	EPA 8290	39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran
		3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin
		67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran
		35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin
		55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran
		70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran
		39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin
		57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran
		57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
		72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran
		19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
		57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran
		40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin
		60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran
		57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran
		51207-31-9	2,3,7,8-Tetrachlorodibenzofuran
		1746-01-6	2,3,7,8-Tetrachlororodibenzo-p-dioxin
Asbestos	ISO 10312 TEM	1332-21-4	Asbestos
General Chemistry Parameters	EPA 9010/9014	57-12-5	Cyanide (Total)
	EPA 9045C	pH	pH in soil
Metals	EPA 6020/6010B	7429-90-5	Aluminum
		7440-36-0	Antimony
		7440-38-2	Arsenic
		7440-39-3	Barium
		7440-41-7	Beryllium
		7440-42-8	Boron
		7440-43-9	Cadmium
		7440-70-2	Calcium
		7440-47-3	Chromium
		7440-48-4	Cobalt
		7440-50-8	Copper
		7439-89-6	Iron
		7439-92-1	Lead
		1313-13-9	Lithium
		7439-95-4	Magnesium
		7439-96-5	Manganese
		7439-98-7	Molybdenum
		7440-02-0	Nickel
		7440-03-1	Niobium
		7440-05-3	Palladium
		7723-14-0	Phosphorus
		7440-06-4	Platinum
		7440-09-7	Potassium
		7782-49-2	Selenium
		7440-21-3	Silicon
		7440-22-4	Silver
		7440-23-5	Sodium

TABLE 2
2006 BORROW AREA INVESTIGATION PROJECT LIST OF ANALYTES
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Chemical Group	Analytical Method	CAS Number	Compound List
Metals (continued)	**EPA 6020/6010B**	7440-24-6	Strontium
		7704-34-9	Sulfur
		7440-28-0	Thallium
		7440-31-5	Tin
		7440-32-6	Titanium
		7440-33-7	Tungsten
		7440-61-1	Uranium
		7440-62-2	Vanadium
		7440-66-6	Zinc
		7440-67-7	Zirconium
	EPA 7196A[1]	18540-29-9	Chromium (VI)
	EPA 7470/7471A	7439-97-6	Mercury
Organophosphorous Pesticides	**EPA 8141A**	264-27-19	Azinphos-ethyl
		86-50-0	Azinphos-methyl
		786-19-6	Carbophenothion
		2921-88-2	Chlorpyrifos
		56-72-4	Coumaphos
		298-03-3	Demeton-O
		126-75-0	Demeton-S
		333-41-5	Diazinon
		62-73-7	Dichlorvos
		60-51-5	Dimethoate
		298-04-4	Disulfoton
		2104-64-5	EPN
		13194-48-4	Ethoprop
		56-38-2	Ethyl parathion
		52-85-7	Fampphur
		55-38-9	Fenthion
		121-75-5	Malathion
		953-17-3	Methyl carbophenothion
		298-00-0	Methyl parathion
		7786-34-7	Mevinphos
		300-76-5	Naled
		297-97-2	O,O,O-Triethyl phosphorothioate (TEPP)
		298-02-2	Phorate
		732-11-6	Phosmet
		299-84-3	Ronnel
		22248-79-9	Stirophos (Tetrachlorovinphos)
		3689-24-5	Sulfotep
Chlorinated Herbicides	**EPA 8151A**	93-76-5	2,4,5-T
		93-72-1	2,4,5-TP (Silvex)
		94-75-7	2,4-D
		94-82-6	2,4-DB
		75-99-0	Dalapon
		1918-00-9	Dicamba

TABLE 2
2006 BORROW AREA INVESTIGATION PROJECT LIST OF ANALYTES
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Chemical Group	Analytical Method	CAS Number	Compound List
Chlorinated Herbicides (continued)	EPA 8151A	120-36-5	Dichloroprop
		88-85-7	Dinoseb
		94-74-6	MCPA
		93-65-2	MCPP
Organochlorine Pesticides	EPA 8081A	53-19-0	2,4-DDD
		3424-82-6	2,4-DDE
		72-54-8	4,4-DDD
		72-55-9	4,4-DDE
		50-29-3	4,4-DDT
		309-00-2	Aldrin
		319-84-6	alpha-BHC
		5103-71-9	alpha-Chlordane
		319-85-7	beta-BHC
		57-74-9	Chlordane
		319-86-8	delta-BHC
		60-57-1	Dieldrin
		959-98-8	Endosulfan I
		33213-65-9	Endosulfan II
		1031-07-8	Endosulfan sulfate
		72-20-8	Endrin
		7421-93-4	Endrin aldehyde
		53494-70-5	Endrin ketone
		58-89-9	gamma-BHC (Lindane)
		5103-74-2	gamma-Chlordane
		76-44-8	Heptachlor
		1024-57-3	Heptachlor epoxide
		72-43-5	Methoxychlor
		8001-35-2	Toxaphene
Polychlorinated Biphenyls	EPA 8082	12674-11-2	Aroclor 1016
		11104-28-2	Aroclor 1221
		11141-16-5	Aroclor 1232
		53469-21-9	Aroclor 1242
		12672-29-6	Aroclor 1248
		11097-69-1	Aroclor 1254
		11096-82-5	Aroclor 1260
Polynuclear Aromatic Hydrocarbons	EPA 8310[2]	83-32-9	Acenaphthene
		208-96-8	Acenaphthylene
		120-12-7	Anthracene
		56-55-3	Benzo(a)anthracene
		50-32-8	Benzo(a)pyrene
		205-99-2	Benzo(b)fluoranthene
		191-24-2	Benzo(g,h,i)perylene
		207-08-9	Benzo(k)fluoranthene
		218-01-9	Chrysene
		53-70-3	Dibenzo(a,h)anthracene
		193-39-5	Indeno(1,2,3-cd)pyrene
		85-01-8	Phenanthrene
		129-00-0	Pyrene

TABLE 2
2006 BORROW AREA INVESTIGATION PROJECT LIST OF ANALYTES
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Chemical Group	Analytical Method	CAS Number	Compound List
Radiochemicals	EPA 901.1/ HASL GA-01-R	14331-83-0	Actinium-228
		14913-49-6	Bismuth-212
		14733-03-0	Bismuth-214
		13981-50-5	Cobalt-57
		10198-40-0	Cobalt-60
		14255-04-0	Lead-210
		015816-77-0	Lead-211
		15092-94-1	Lead-212
		15067-28-4	Lead-214
		13966-00-2	Potassium-40
		14913-50-9	Thallium-208
		15623-47-9	Thorium-227
		15065-10-8	Thorium-234 (from U-235)
	EPA 903.0	13982-63-3	Radium-226
	EPA 904.0	15262-20-1	Radium-228
	Quantitate from Parent or Daughter Radionuclide	14952-40-0	Actinium-227 (from Th-227)
		14331-79-4	Bismuth-210 (from Pb-210)
		15229-37-5	Bismuth-211 (from Pb-211)
		13981-52-7	Polonium-210 (from Pb-210)
		13981-52-7	Polonium-212 (from Bi-212)
		15735-67-8	Polonium-214 (from Bi-214)
		15756-58-8	Polonium-216 (from Pb-212)
		15422-74-9	Polonium-218 (from Pb-214)
		15100-28-4	Protactinium-234 (from Th-234)
		15623-45-7	Radium-223 (from Th-227)
		13233-32-4	Radium-224 (from Pb-212)
		14133-67-6	Thallium-207 (from Pb-211)
		14932-40-2	Thorium-231 (from U-235)
		7440-29-1	Thorium-232
		14274-82-9	Thorium-228
		14269-63-7	Thorium-230
		13966-29-5	Uranium-233/234
		15117-96-1	Uranium 235/236
		7440-61-1	Uranium-238(from Th-234)
Semivolatile Organic Compounds	EPA 8270C[2]	95-94-3	1,2,4,5-Tetrachlorobenzene
		122-66-7	1,2-Diphenylhydrazine
		123-91-1	1,4-Dioxane
		3457-46-3	2,2'-Dichlorobenzil
		95-95-4	2,4,5-Trichlorophenol
		88-06-2	2,4,6-Trichlorophenol
		120-83-2	2,4-Dichlorophenol
		105-67-9	2,4-Dimethylphenol
		51-28-5	2,4-Dinitrophenol
		121-14-2	2,4-Dinitrotoluene
		606-20-2	2,6-Dinitrotoluene
		91-58-7	2-Chloronaphthalene
		95-57-8	2-Chlorophenol
		91-57-6	2-Methylnaphthalene

Chemical Group	Analytical Method	CAS Number	Compound List
Semivolatile Organic Compounds (continued)	**EPA 8270C**[3]	88-74-4	2-Nitroaniline
		88-75-5	2-Nitrophenol
		91-94-1	3,3-Dichlorobenzidine
		99-09-2	3-Nitroaniline
		3457-46-3	4,4'-Dichlorobenzil (as 2,2'-dichlorobenzil)
		101-55-3	4-Bromophenyl phenyl ether
		59-50-7	4-Chloro-3-methylphenol
		7005-72-3	4-Chlorophenyl phenyl ether
		123-09-1	4-Chlorothioanisole
		106-54-7	4-Chlorothiophenol
		100-01-6	4-Nitroaniline
		100-02-7	4-Nitrophenol
		83-32-9	Acenaphthene
		208-96-8	Acenaphthylene
		98-86-2	Acetophenone
		62-53-3	Aniline
		120-12-7	Anthracene
		103-33-3	Azobenzene
		56-55-3	Benzo(a)anthracene
		50-32-8	Benzo(a)pyrene
		205-99-2	Benzo(b)fluoranthene
		191-24-2	Benzo(g,h,i)perylene
		207-08-9	Benzo(k)fluoranthene
		65-85-0	Benzoic acid
		100-51-6	Benzyl alcohol
		111-91-1	bis(2-Chloroethoxy)methane
		54-28-1	bis(2-Chloroethyl) ether
		108-60-1	bis(2-Chloroisopropyl) ether
		117-81-7	bis(2-Ethylhexyl) phthalate
		111-44-4	bis(Chloromethyl) ether
		80-07-9	bis(p-Chlorophenyl) sulfone
		1142-19-4	bis(p-Chlorophenyl)disulfide
		85-68-7	Butylbenzyl phthalate
		86-74-8	Carbazole
		218-01-9	Chrysene
		53-70-3	Dibenzo(a,h)anthracene
		132-64-9	Dibenzofuran
		542-88-1	Dichloromethyl ether
		84-66-2	Diethyl phthalate
		131-11-3	Dimethyl phthalate
		84-74-2	Di-n-butyl phthalate
		117-84-0	Di-n-octyl phthalate
		882-33-7	Diphenyl disulfide
		139-66-2	Diphenyl sulfide
		127-63-9	Diphenyl sulfone
		206-44-0	Fluoranthene
		86-73-7	Fluorene
		118-74-1	Hexachlorobenzene

Chemical Group	Analytical Method	CAS Number	Compound List
Semivolatile Organic Compounds (continued)	**EPA 8270C**[3]	87-68-3	Hexachlorobutadiene
		77-47-4	Hexachlorocyclopentadiene
		67-72-1	Hexachloroethane
		118-29-6	Hydroxymethyl phthalimide
		193-39-5	Indeno(1,2,3-cd)pyrene
		78-59-1	Isophorone
		106-44-5	m,p-Cresol
		91-20-3	Naphthalene
		98-95-3	Nitrobenzene
		621-64-7	N-nitrosodi-n-propylamine
		86-30-6	N-nitrosodiphenylamine
		95-48-7	o-Cresol
		29082-74-4	Octachlorostyrene
		106-47-8	p-Chloroaniline (4-Chloroaniline)
		106-54-7	p-Chlorobenzenethiol
		608-93-5	Pentachlorobenzene
		87-86-5	Pentachlorophenol
		85-01-8	Phenanthrene
		108-95-2	Phenol
		129-00-0	Pyrene
		110-86-1	Pyridine
		108-98-5	Thiophenol
			Tentatively Identified Compounds (TICs)
Volatile Organic Compounds	**EPA 8260B**	630-20-6	1,1,1,2-Tetrachloroethane
		71-55-6	1,1,1-Trichloroethane
		79-34-5	1,1,2,2-Tetrachloroethane
		79-00-5	1,1,2-Trichloroethane
		75-34-3	1,1-Dichloroethane
		75-35-4	1,1-Dichloroethene
		563-58-6	1,1-Dichloropropene
		87-61-6	1,2,3-Trichlorobenzene
		96-18-4	1,2,3-Trichloropropane
		120-82-1	1,2,4-Trichlorobenzene
		95-63-6	1,2,4-Trimethylbenzene
		95-50-1	1,2-Dichlorobenzene
		107-06-2	1,2-Dichloroethane
		540-59-0	1,2-Dichloroethene
		78-87-5	1,2-Dichloropropane
		108-70-3	1,3,5-Trichlorobenzene
		108-67-8	1,3,5-Trimethylbenzene
		541-73-1	1,3-Dichlorobenzene
		542-75-6	1,3-Dichloropropene
		142-28-9	1,3-Dichloropropane
		106-46-7	1,4-Dichlorobenzene
		594-20-7	2,2-Dichloropropane
		95-49-8	2-Chlorotoluene
		591-78-6	2-Hexanone
		79-46-9	2-Nitropropane

Chemical Group	Analytical Method	CAS Number	Compound List
Volatile Organic Compounds (continued)	**EPA 8260B**	108-90-7	4-Chlorobenzene
		106-43-4	4-Chlorotoluene
		108-10-1	4-Methyl-2-pentanone (MIBK)
		67-64-1	Acetone
		75-05-8	Acetonitrile
		71-43-2	Benzene
		108-86-1	Bromobenzene
		75-27-4	Bromodichloromethane
		75-25-2	Bromoform
		74-83-9	Bromomethane
		75-15-0	Carbon disulfide
		56-23-5	Carbon tetrachloride
		108-90-7	Chlorobenzene
		74-97-5	Chlorobromomethane
		124-48-1	Chlorodibromomethane
		75-00-3	Chloroethane
		67-66-3	Chloroform
		74-87-3	Chloromethane
		156-59-2	cis-1,2-Dichloroethene
		10061-01-5	cis-1,3-Dichloropropene
		99-87-6	Cymene (Isopropyltoluene)
		73506-94-2	Dibromochloroethane
		124-48-1	Dibromochloromethane
		96-12-8	Dibromochloropropane
		74-95-3	Dibromomethane
		25321-22-6	Dichlorobenzene
		75-09-2	Dichloromethane (Methylene chloride)
		624-92-0	Dimethyldisulfide
		64-17-5	Ethanol
		100-41-4	Ethylbenzene
		75-69-4	Freon-11(Trichlorofluoromethane)
		76-13-1	Freon-113(1,1,2-trichloro-1,2,2-trifluoroethane)
		75-71-8	Freon-12(Dichlorodifluoromethane)
		142-82-5	Heptane
		31394-54-4	Isoheptane
		98-82-8	Isopropylbenzene
		mp-XYL	m,p-Xylene
		78-93-3	Methyl ethyl ketone (2-Butanone)
		74-88-4	Methyl iodide
		1634-04-4	MTBE (Methyl tert-butyl ether)
		104-51-8	n-Butyl benzene
		103-65-1	n-Propylbenzene
		124-19-6	Nonanal
		95-47-6	o-Xylene
		135-98-8	sec-Butylbenzene
		100-42-5	Styrene
		98-06-6	tert-Butyl benzene
		127-18-4	Tetrachloroethene

TABLE 2
2006 BORROW AREA INVESTIGATION PROJECT LIST OF ANALYTES
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Chemical Group	Analytical Method	CAS Number	Compound List
Volatile Organic Compounds (continued)	**EPA 8260B**	108-88-3	Toluene
		156-60-5	trans-1,2-Dichloroethene
		10061-02-6	trans-1,3-Dichloropropene
		71-55-6	Trichloroethane
		79-01-6	Trichloroethene
		108-05-4	Vinyl acetate
		75-01-4	Vinyl chloride
		1330-20-7	Xylenes (total)
			Tentatively Identified Compounds (TICs)

Notes:

Laboratory limits are subject to matrix interferences and may not always be achieved in all samples.

The laboratory was instructed to report the top 25 Tentatively Identified Compounds (TICs) under Methods 8260B and 8270C.

[1] = Hexavalent chromium analyses used an alkaline digestion procedure for extracting hexavalent chromium prior to analysis.

[2] = For SVOCs, Method 8270C is the primary analytical method, but for risk assessment purposes results from Method 8310 will be used.

[3] = Method 3540 for extraction and Method 3640 for cleanup are to be used as appropriate.

TABLE 3
FATE AND TRANSPORT MODEL INPUT VALUES FOR AIR EPCs
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Parameter	Abbrev.	Value	Units	Reference
Outdoor Air Parameters				
Particulate emission factor[a]	PEF	1.36 E+9	m^3/kg	USEPA 2002d
Volatilization factor	VF	---chemical-specific---		USEPA 2002d
Dispersion factor for volatiles emitted from soil[b]	Q/C_{vol}	83.1	g/m^2-s per kg/m^3	USEPA 2002d
Construction Dust Parameters				
Fraction of vegetative cover	V	0	--	USEPA 2002d
Mean annual wind speed	U	4.0 (8.9 mph)	m/s	(1)
Equivalent threshold value of wind speed	U_t	11.3	m/s	USEPA 2002d
Function dependent on U/U_t	F(x)	0.194	--	USEPA 2002d
Wet soil bulk density	r_{soil}	1.74	Mg/m^3	(2)
Percent moisture in soil	M	17.7	%	site-specific[c]
Depth of site excavation	d_{excav}	11 (35 ft)	m	site-specific[c]
Number of times soil is dumped	N_A	2.0	--	USEPA 2002d
Percent weight of silt in soil	s	9.4	%	site-specific[c]
Mean vehicle speed	S_{doz}	11.4	km/hr	USEPA 2002d
Areal extent of site tilling	A_{till}	3.6	acre	(3)
Number of times soil is tilled	N_A	2.0	--	USEPA 2002d
Subchronic dispersion factor for area source-Constant A	A	2.454	--	USEPA 2002d
Subchronic dispersion factor for area source-Constant B	B	17.566	--	USEPA 2002d
Subchronic dispersion factor for area source-Constant C	C	189.043	--	USEPA 2002d
Width of road segment	W_R	6.1	m	USEPA 2002d
Mean vehicle weight	W	8.0	tonnes	USEPA 2002d
Number of days/year ≥ 0.01 inches	p	27.0	days	(1)
Subchronic dispersion factor for road segment-Constant A	A	12.935	--	USEPA 2002d
Subchronic dispersion factor for road segment-Constant B	B	5.738	--	USEPA 2002d
Subchronic dispersion factor for road segment-Constant C	C	71.771	--	USEPA 2002d
Areal extent of site surface contamination	A_{surf}	17.8	acres	site-specific[c]

[a]For non-construction worker exposures only. Construction worker dust exposures calculated from USEPA (2002d).

[b]Calculated from default parameters for Las Vegas, NV in Appendix D of USEPA (2002d) .

[c]Average of all available site-specific data collected from the Borrow Area.

(1) - Based on long-term weather data for the area of interest (WRCC 2006, On-line. http://www.wrcc.dri.edu/).

(2) - Based on data from vicinity investigations (from data collected in the BMI Common Areas in 2004 and Environ [2003]).

(3) - Assumed value of one fifth of the site based upon USEPA (2002d).

TABLE 4
DETERMINISTIC EXPOSURE FACTORS – CONSTRUCTION WORKERS
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Parameter	Abbrev.	Value	Units	Reference
Construction worker dermal adherence factor	AF_{cw}	0.3	mg/cm^2	USEPA 2002d
Averaging time, carcinogenic	AT_c	70	years	USEPA 1991
Averaging time, non-carcinogenic	AT_{nc}	1	years	Based on ED_{cw}
Adult body weight	BW_a	70	kg	USEPA 1991
Construction worker exposure frequency	EF_{cw}	250	days/year	USEPA 1991
Exposure duration	ED_{cw}	1	years	(1)
Adult inhalation rate	$IR_{a'}$	20	m^3/day	USEPA 2002d
Construction worker exposed surface area	SA_{cw}	3,300	cm^2/day	USEPA 2002d
Construction worker soil ingestion rate	$IR_{s,cw}$	330	mg/day	USEPA 2002d
<u>Radionuclide-specific factors</u>				
Exposure time fraction, indoors	$ET_{cw,i}$	0	unitless	(2)
Exposure time fraction, outdoors	$ET_{cw,o}$	0.33	unitless	(2)
Area correction factor	ACF_{cw}	0.9	unitless	USEPA 2000b, 2006a
Gamma shielding factor	GSF	0.4	unitless	USEPA 2000b, 2006a

(1) Based on site data. A one-year exposure duration is appropriate for carcinogenic effects, because the methodology averages exposures over a lifetime (see USEPA 2002d).

(2) Assumes worker spends 100% of time outdoors, 8 hours a day.

TABLE 5

DETERMINISTIC EXPOSURE FACTORS – OUTDOOR MAINTENANCE WORKERS[a]

BORROW AREA RISK ASSESSMENT WORK PLAN

CLARK COUNTY, NEVADA

Parameter	Abbrev.	Value	Units	Reference
Maintenance worker dermal adherence factor	AF_{mw}	0.2	mg/cm^2	USEPA 2002d
Averaging time, carcinogenic	AT_c	70	years	USEPA 1991
Averaging time, non-carcinogenic	AT_{nc}	25	years	Based on ED_{mw}
Adult body weight	BW_a	70	kg	USEPA 1991
Maintenance worker exposure frequency	EF_{mw}	225	days/year	USEPA 2002d
Exposure duration	ED_{mw}	25	years	USEPA 2002d
Adult inhalation rate	$IR_{a'}$	20	m^3/day	USEPA 2002d
Maintenance worker exposed surface area	SA_{mw}	3,300	cm^2/day	USEPA 2002d
Maintenance worker soil ingestion rate	$IR_{s,mw}$	100	mg/day	USEPA 2002d
<u>Radionuclide-specific factors</u>				
Maintenance worker exposure fraction, indoors	$ET_{mw,i}$	0	unitless	(1)
Maintenance worker exposure fraction, outdoors	$ET_{mw,o}$	0.33	unitless	(1)
Maintenance worker area correction factor	ACF_{mw}	0.9	unitless	USEPA 2000b, 2006a
Maintenance worker gamma shielding factor	GSF	0.4	unitless	USEPA 2000b, 2006a

[a]Exposure parameters for maintenance workers are based on outdoor worker exposure factors, from USEPA (2002d).

(1) Assumes worker spends 100% of time outdoors, 8 hours a day.

TABLE 6
DETERMINISTIC EXPOSURE FACTORS – TRESPASSERS[a]
BORROW AREA RISK ASSESSMENT WORK PLAN
CLARK COUNTY, NEVADA

Parameter	Abbrev.	Value	Units	Reference
Trespasser dermal adherence factor	AF_t	0.2	mg/cm^2	USEPA 2002d
Averaging time, carcinogenic	AT_c	70	years	USEPA 1991
Averaging time, non-carcinogenic	AT_{nc}	6	years	Based on ED_t
Trespasser body weight	BW_t	60.2	kg	USEPA 1997
Trespasser exposure frequency	EF_t	50	days/year	Professional judgment
Trespasser exposure time	ET	4	hrs/day	Professional judgment
Exposure duration	ED_t	6	years	USEPA 1997
Trespasser inhalation rate	$IR_{t'}$	1.2	m^3/hr	USEPA 1997
Trespasser exposed surface area[b]	SA_t	4,400	cm^2/day	USEPA 1997, 2004b
Trespasser soil ingestion rate	$IR_{s,t}$	100	mg/day	USEPA 1997
<u>Radionuclide-specific factors</u>				
Trespasser exposure fraction, indoors	$ET_{t,i}$	0	unitless	(1)
Trespasser exposure fraction, outdoors	$ET_{t,o}$	0.17	unitless	(1)
Trespasser area correction factor	ACF_t	0.9	unitless	USEPA 2000b, 2006a
Trespasser gamma shielding factor	GSF	0.4	unitless	USEPA 2000b, 2006a

[a]Assumes a teenager from 13 to 19 years of age. Age-specific exposure factors reflect this age range (that is, body weight, inhalation rate, exposure surface area, and ingestion rate).

[b]Average from 13 to 19 years of age for head, forearms, hands, and lower legs.

(1) Assumes trespasser spends 100% of time outdoors, 4 hours a day.

APPENDIX A

NDEP COMMENTS ON THE BORROW AREA HUMAN HEALTH RISK ASSESSMENT WORK PLAN AND BRC RESPONSE TO COMMENTS

APPENDIX A-1
Response to NDEP Comments Dated August 25, 2006 on the July 2006 BRC Human Health Risk Assessment Work Plan, Revision 2

General Discussion: *BRC and NDEP have had several discussions after these comments were received. The following discussion is provided to give some context to the BRC responses below to specific NDEP comments. Most of NDEP's comments pertain to the use of the VLEACH model – specifically with regards to input parameters for this model.*

BRC now expects that most if not all of the Borrow materials will likely be usable in the BMI industrial complex itself, including during CAMU construction. Typically, and consistent with prior constraints agreed to with the NDEP, these materials will be used as road bed, in pads for industrial buildings, and for CAMU construction. In all cases, materials will be used with cover such that they are not directly exposed to the ambient air. It is also expected that, in most situations, the cover will also impede (or, in some cases completely block) infiltration. It should be noted, that as a general matter, the properties of soils in the BMI complex are not too different from that in the current Borrow Pit area, since they are part of the same alluvial fan. Also, the depths to groundwater in the complex range from roughly 35 feet bgs to around 60 or so feet bgs. Figure 2 has been added to the report which shows the locations of proposed Borrow material use sites.

BRC notes that the purpose of using VLEACH in this context is to predict, conservatively, impacts to groundwater. Even though VLEACH can also be used to determine impacts to air and distribution of contaminants in the soil column, that is not the intent here. It is being used simply to screen out potential impacts to groundwater.

The VLEACH manual (Model Version 2.2a, EPA, 1997) discusses the model structure (i.e., the soil matrix is divided into "polygons" for capturing lateral heterogeneity and "cells" which are vertical divisions within each polygon.) In the present case, only one polygon will be used since the purpose of the modeling is to determine whether Borrow materials placed at any location (with potential residual contamination) can leach to groundwater beneath the placement. This placement, after excavation, will not create lateral heterogeneity at a given placement location – hence multiple polygons are not required. Regarding the vertical dimension, Borrow Area materials will be placed on top of varying lengths of native (or extant) soil layers. Thus, vertically, after placement of Borrow materials, there will be two layers of materials above groundwater (disregarding any cap materials at the very top near the ground surface) – namely the Borrow materials and, beneath them, the extant native materials at the placement location, and finally groundwater. Thus, there will be, at a minimum, two stacked material "layers" in the vertical dimension. Of course, these layers can be further divided into smaller VLEACH cells which facilitate computational needs within each layer.

The VLEACH manual also discusses all of the inputs required to run the model – in general they include contaminant properties (such as diffusion coefficients, Henry Law's coefficients, organic partitioning coefficients, etc.); infiltration rate; and geophysical properties of the soil column. BRC does not plan to change model assumptions regarding contaminant properties. Regarding infiltration rate, the work plan discusses the input to be used. In order to understand the sen-

sitivity of this parameter, sensitivity runs covering a range of infiltration rates (the range will be similar to that used in the VLEACH manual) will be conducted The geophysical properties needed for running the model (namely bulk density, effective porosity, moisture content, and organic fraction in soil) can, in general, be different for each of these layers. In order to therefore determine these properties at a given potential placement location, BRC will do the following:

(a) Obtain these parameters from Borrow materials which have already been excavated – these will be representative of the Borrow materials portion of the as-placed layer in the placement location. In order to facilitate the development of the geophysical input parameters for the Borrow materials, BRC has developed and NDEP has approved a work plan for sampling Borrow materials that have been excavated from this area prior. This sampling will provide bulk density, effective porosity, moisture content, and soil organic fraction;

(b) Obtain these parameters from a potential placement location, once such a location is determined. These parameters will be representative of the native materials layer under the Borrow materials in the as-placed location. Or, demonstrate to NDEP that for a different potential placement location, why parameters obtained previously may be representative (such as if the two placement locations are nearby and of similar geology).

The VLEACH manual discusses the effects of the various geophysical parameters on the predicted groundwater concentrations (See Section 8 of the VLEACH manual). Parameters that have high sensitivity (for predicted groundwater impacts) include: contaminant organic carbon partition coefficient (not proposed to be changed in the model); infiltration rate (which will be varied to cover a conservative range of values); and the fraction organic carbon in soil (which will be obtained from field measurements). It should be noted that, in several proposed uses (such as base materials for a concrete building pad) there should be no infiltration at all. Parameters that have moderate sensitivity include bulk density (to be determined from field measurements) and moisture content (to be obtained from field measurements). Other parameters including soil porosity show low sensitivity (see Figure 8.1 of the VLEACH manual).

Because the model does not allow for the input of heterogeneous soils in the vertical directions, BRC proposes running the model in a 'stacked' fashion. That is, the model will be run twice, first with the Borrow materials soil properties, assuming contaminant concentrations throughout this first 'layer'. Outputs from this initial model run will then be used as contaminant inputs to the second model run, which will use the extant native materials soil properties. BRC consultants have had discussions with one of the USEPA developers of the model concerning this approach. EPA has indicated in these discussions that this is an appropriate way to use the model under vertically heterogeneous soil conditions. A discussion on this is provided in Section 2.1.1 of the work plan.

1. Section 2.1, Conceptual Site Model, pg. 4, 2nd paragraph. The intended use of the model is to predict "impacts to groundwater considering the use of Borrow Area soils as off-site fill material."

Response: *Comment noted. The text has been revised as suggested (see Section 2.1.1).*

a. The following comes from the VLEACH user manual which is downloaded with the program from the EPA Center for Subsurface Modeling Support. "In particular, VLEACH simulates vertical transport by advection in the liquid phase and by gaseous diffusion in the vapor phase…These processes are conceptualized as occurring in a number of distinct, user-defined polygons that are vertically divided into a series of user-defined cells. The polygons may differ in soil properties, recharge rate, and depth to water… However, within each polygon homogeneous conditions are assumed except for contaminant concentration, which can vary between layered cells…" Emphasis added.

Response: *Comment noted. Although homogeneous conditions are assumed in each polygon, please note that BRC will use two vertically stacked layers in the polygon to represent the Borrow materials and the underlying native materials, respectively. A discussion on this approach has been added to Section 2.1.1.*

b. The VLEACH model referenced in the Human Health Risk Assessment Work Plan for the Borrow Area used a combination of Site-specific soil, City of Henderson (CoH) WRF soil, and general reference soil input parameters when the borrow material will be transported to another location with presumably different soil properties between the borrow fill material and groundwater. Thus, it would seem that the model does not represent potential leaching conditions at the point of use and according to the user manual the model does not accommodate more than one soil type in a vertical polygon. Please provide the rationale for the proposed use of the VLEACH model and the application of model results.

Response: *BRC has revised its approach regarding inputs noted in this Comment. Please see the General Discussion above. Soil properties will be collected from Borrow materials as well as native materials at the placement location. Thus, these properties will be representative. Also see response to comment 1a above.*

c. It is not clear to the NDEP why BRC did not collect and analyze or utilize Borrow Site specific soil samples for the input parameters.

Response: *Please see the General Discussion above. BRC will obtain Borrow Site specific soil samples for input parameters.*

d. See additional comments below.

Response: *No response necessary.*

2. Table 1, the NDEP has the following comments:

   a. Soil porosity can be estimated from the bulk density.

$$n = 1 - \frac{\rho_b}{\rho_s}$$

where: ρb = 1.78 g/cm3 (Table 1), and
ρs = 2.65 g/cm3 (quartz).

This yields n = 0.33 for total porosity with the given information. Comparing the calculated value with the reported 0.35 for effective porosity, the value of 0.35 appears high. BRC should provide the rationale for all the soil input parameters used in the VLEACH model.

Response: *BRC notes (VLEACH Manual, Figure 8-14) that soil porosity is not a sensitive parameter with regards to groundwater impact prediction. In fact, the Figure shows that there was no appreciable change in groundwater impacts even though porosity was varied between 0.35 and 0.45. Thus, BRC does not believe that its previous suggested input value of 0.35 and NDEP's suggested value of 0.33 will make a material difference in the results. Finally, as discussed earlier, BRC is proposing to use laboratory data from field samples for porosity so this issue is now moot.*

b. Soil saturation percent can be calculated from the porosity and soil volumetric water content:

$$S_s = \frac{\theta}{n} \times 100$$

where: θ = volumetric water content = 0.18 (Table 1), and
n = porosity = 0.35 (Table 1).

Response: *As discussed earlier, BRC is proposing to collect and use actual field measurements.*

c. The proposed effective porosity for the sand and gravel mixture and the average volumetric moisture content gives a saturation of about 50%. If the calculated porosity of 0.33 is used, the soil saturation is estimated at 55%. The range of 50-55% seems to be high for a sand and gravel mixture given the local climate. Please provide rationale for the effective porosity value and moisture content for Borrow Area soils.

Response: *BRC notes that volumetric water content and porosity needed for the model will be obtained from field measurements.*

d. The mass balance should be checked to confirm that the timestep and number of cells provide a stable solution. It should be kept in mind that reducing the timestep can stabilize the solution.

Response: *Comment noted, this will be confirmed at the time of the modeling.*

e. BRC's comments regarding the recharge rate are technically sound but a sensitivity run (or runs) should be completed if the area is to be irrigated or otherwise have water added.

Response: *BRC agrees. A range of infiltration rates, similar to that used in the VLEACH manual (from example, from 2 to 6 inches per year) will be used in the model.*

f. The rationale for using the percent soil organic carbon content from the CoH WRF soils needs to be provided. Some of the areas evaluated in the CoH WRF were groundwater discharge areas where the soil presumably was either saturated for some time or is currently saturated. This may allow for the build up of organic matter in the soil horizons sampled due to past or present vegetation in the area. Given that the borrow material is described as a sand and gravel mixture the value of 0.33 appears high. BRC needs to explain the comparability between the two locations for this parameter (soil percent organic carbon).

Response: *This parameter will be obtained from field measurements.*

3. Table 3, the NDEP has the following comments:
   a. Please edit the title to Table 3 to read "Fate and Transport Model Input Values for Air EPCs".

Response: *The title has been changed as requested.*

   b. An additional question for Table 3 relates to the areal extent of contamination. "Asurf" is defined as 17.8 acres. This is approximately the entire acreage of the north and south portions of the Borrow Area. It is assumed by BRC that one-fifth of the site is the areal extent of the tilling operation ("Atill"). Please provide rationale for this assumption and explain how this relates to the NDEP's understanding that "mass grading" will take place at the site.

Response: *The construction dust emissions assume excavation, soil dumping, dozing, grading, and tilling operations. Given the nature of the operations that will occur at the site regarding excavation and placement of soil off-site, it was considered unlikely that a large amount of tilling will occur. Given this, the tilling area value of 1/5th used in the particulate matter case example from USEPA 2002 (Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; page E-26) was proposed. This is independent of the grading part of the equation, which assumes grading over the entire areal extent.*

4. Appendix A-1, Response-to-comment (RTC) 1, it is not evident that Revision 2 complies with SOP-0, which establishes specific quality assurance and quality control (QA/QC) procedures. QA/QC problems not corrected include, but are not limited to:
   c. The redline/strikeout version does not match the edited (edits accepted) version (e.g., table of contents);

Response: *The TOC in the main text doesn't match that in the redline/strikeout version because the redline/strikeout version text includes both additions and deletions, thus the page numbering is necessarily different.*

d. Text formatting/font jumbling in text and tables;

Response: *This is due to differences in the versions of Adobe Acrobat used. BRC regrets the text jumble and will take every measure to avoid this in the future.*

e. Lack of documentation that the QA/QC reviewer has independently confirmed that data and proposed parameter values are correct;

Response: *A QA/QC reviewer signature has been added to the report.*

f. Inconsistencies in response-to-comments.

Response: *Comment noted. BRC regrets the error and will avoid this in the future.*

5. Appendix A-1, RTC 6c, please delete the second and third sentences of the first full paragraph on page 4 of the redline/strikeout of Revision 2 (paragraph begins with "The potentially exposed…"). Please edit the fourth sentence as follows: "The VLEACH modeling will be conducted for the chemicals of potential concern…". Also, please edit Figure 2 (CSM), gray box regarding VLEACH as follows: "This pathway will be evaluated…".

Response: *Change to the redline/strikeout of Revision 2 have not been made because this version of the report includes the redline/strikeout for Revision 3. The change to the main text regarding VLEACH modeling has been made (see Section 2.1.1). Figure 2 (now Figure 3) has been changed as requested.*

6. Appendix A-1, RTC 6e, in order for NDEP to approve the soil input parameter values listed in Table 1, the laboratory reports for the data, sample locations, data validation, and data usability evaluation for those data, need to be provided to NDEP.

Response: *Please see General Discussion earlier. BRC will provide all lab data relating to soil parameters that will be used in the model.*

7. Appendix A-1, RTC 6.f.i., as previously requested, the methodology by which the VLEACH process will be completed should be presented in conjunction with the input parameters. Also, it should be noted which parameters are specific to the site where the material will be placed versus parameters that will be generated from the borrow material itself. Finally, NDEP prefers that the VLEACH modeling be specific to the HRA and not based on

"updates" from the previous modeling, which was not approved by NDEP (and will not be approved by the NDEP).

Response: *Please see Section 2.1.1 for an expanded discussion on the VLEACH process that will be used along with how the input parameters will be used. Please also see the General Discussion above. This addresses NDEP's concern regarding properties pertinent to the Borrow materials as well as native materials. NDEP's last sentence in this comment is noted. References to previous modeling have been removed.*

8. Appendix A-1, RTC 6.f.ii., please insure that the risk assessment report contains an RTC letter which contains all of the NDEP's comments on VLEACH from the NDEP's May 19, 2006 letter, July 10, 2006 letter, this letter and any additional comments generated between now and then. Failure to do so will result in rejection of the risk assessment report without review.

Response: *Comment noted. The risk assessment report will include the RTCs.*

9. Appendix A-1, RTC 6.f.iii., Figure 2, the CSM, indicates that construction workers are receptors for the off-site fill material scenario, which is a reasonable assumption. Accordingly, the construction dust model is applicable for construction workers involved with fill activities off-site.

Response: *Comment noted, a reference to this has been added to the text in Section 4.2. (Note: Figure 2 is now Figure 3).*

10. Appendix A-1, RTC 6.f.iv., either a worst-case soil type should be assumed for the off-site soils underlying where the fill will be placed or, if not, then site-specific information should be used and NDEP should approve that on a case-by-case basis. Applying "generic" assumptions that are not necessarily "worst-case" without site-specific information to document applicability does not necessarily meet HRA Reasonable Maximum Exposure criteria. Additionally, if BRC is proposing a "worst case" scenario, the assumptions made should be discussed and explained why these assumptions constitute a "worst case" scenario.

Response: *Please see General Discussion above as well as Section 2.1.1 describing the methodology that is proposed to be used. Since site specific data are proposed to be used along with model sensitivity runs, BRC believes that the model results will be conservative (i.e., over-predict impacts).*

11. Appendix A-2, NDEP has no comments on this Appendix as the comments were provided via the NDEP's July 10, 2006 letter to BRC.

Response: *Comment noted.*

APPENDIX A-2
Response to NDEP Comments Dated July 10, 2006 on the June 2006 BRC Human Health Risk Assessment Work Plan, Revision 1

1. General comment, please insure that the resubmittal of this document fully complies with SOP-0.

Response: *Comment noted.*

2. General comment, please be sure to provide a full annotated response-to-comments and a red-line mark up of the document when it is resubmitted.

Response: *BRC is providing both documents requested.*

3. General comment, please ensure that x, y and z coordinates are recorded in case an exploratory spatial analysis needs to be completed.

Response: *Comment noted.*

4. Section 2.1.2, first full paragraph, the second constraint placed on Borrow Area soil fill refers to ambient conditions. It appears that the word ambient is used here to refer to surface conditions. This usage is not appropriate and surface conditions should be defined in this context. The intent is to restrict the placement of soils so that there are no pathways for receptors. If this is the case, then it should be stated as such.

Response: *The text has been revised accordingly.*

5. Table 2, neither the text nor Table 2 indicate that some model parameters are pending.

Response: *BRC is confused by this comment. Table 2 states 'pending' for soil moisture and percent silt. All other parameters proposed for use are defined.*

6. Appendix A, response-to-comments (RTC) letter, the NDEP has the following comments:
   a. General comment, please note that that the responses below also results in changes to the remainder of the document. BRC should insure that these changes are completed throughout the document.

Response: *Comment noted. As necessary, BRC has revised the text in the document.*

   b. RTC 4, it is not apparent that BRC has responded to the NDEP's previous comment. This comment references back to an April 4, 2006 meeting between the NDEP and BRC and notes that the previous version of this document did not respond to the NDEP's comments either.

Response: *BRC attempted to respond to the earlier comment via additional discussion in Section 1.2. New language has been added further in response to NDEP comments below.*

i. BRC attempts to define Type II materials by providing a table which lists sieve opening sizes, however, it is not explained how this table relates to the definition of Type II material. Does Type II material include all of these sieve sizes?

Response: *This is clarified in the text in Section 1.2.*

ii. Additionally, BRC does not explain if the material will be mass graded at the site (meaning site-wide excavation) or if the site will be sub-divided and then graded, etc. This type of information is important for completion of a representative risk assessment calculation.

Response: *Within each of the two portions (Northern and Southern) of the Borrow Area, the material is expected to be mass graded. This is clarified in the text.*

iii. Also, BRC has noted that the reject sand may be used in landscape applications. This is contrary to the restrictions placed on the use of the materials from the gravel pit. Please explain.

Response: *BRC has modified the text to indicate that reject sand will be stockpiled for use in CAMU construction or for offsite applications. Should BRC need to use reject sand for offsite uses, its use will be subject to the same constraints as Type II material.*

c. RTC 5c, the NDEP would like to note the following:
   i. As noted by the NDEP in the previous comment letter, "it is premature to model a select list of chemicals that may or may not be chemicals of potential concern". The text revisions that have been made to the document are incomplete. For example, Section 2.1, page 4, states that the evaluation has been completed. In addition, Appendix B includes modeling runs.

Response: *BRC respectfully disagrees with this comment. The document does not state that the evaluation has been completed. Its states that it has been evaluated, but that it will be "…updated based on the chemicals of potential concern (COPCs) identified in the HHRA." In any case, Appendix B as been removed.*

d. RTC 9, BRC's response seems to indicate that the borrow area is not viable habitat because it is in the CAMU boundary. The geographic location of the borrow area is irrelevant with respect to the site's suitability as habitat. A more viable explanation is necessary for this issue.

Response: *The text has been changed to state that no viable habitat is present in the Borrow Area based on field observations. The area (except for the intervening portion of the Western Ditch) has already been graded in anticipation of gravel mining. The Western Ditch contains sparse vegetation and no discernable habitat.*

e. RTC 16, the NDEP has the following comments:
   i. BRC indicates that "site-specific values will be the average of all available data collected from the Borrow Area for a particular parameter." It is not clear that this is a representative method of calculating a parameter and it is not clear that this is conservative.

Response: *BRC has used this approach based on discussions with NDEP and its consultants. BRC believes that this is a reasonable approach. Should NDEP require a different approach, BRC will be happy to discuss it with the NDEP.*

   ii. Please explain if individual batches of borrow materials will be tested for soil moisture, silt content, etc. If so, please explain the volumes of each batch to be tested. If not, please explain how in-situ measurements will be representative of the reject sand and type II materials.

Response: *BRC does not expect to conduct individual batch testing. It will use values for these parameters that are representative and are conservative. If needed, BRC will occasionally sample some of the materials to confirm that the parameter values that are use are representative.*

   iii. Please note that the construction volatization factor will likely be needed for other areas of the project.

Response: *Comment noted.*

f. RTC 27, the NDEP would like to note the following:
   i. It is not clear to the NDEP why comment 27b cannot be addressed at this time. There are other NDEP comments which also could be addressed at this time. In addition, it is not clear why BRC has dismissed the NDEP's comments and is electing to defer completion of the identification of input parameters and the methodology by which the VLEACH process will be completed. If some model parameters will be site-specific they should be identified as such. The methodology by which these parameters will be derived should be discussed. In addition, it should be noted which parameters are specific to the site where the material will be placed versus parameters that will be generated from the borrow material itself.

Response: *BRC did not intend to dismiss NDEP's comments. BRC has attempted to present the VLEACH input parameters that were used, in Appendix B. However, per discussions with NDEP after receiving these comments, BRC is now providing a new Table 1 containing all of the input parameters from VLEACH as well as the source of these parameters.*

ii. BRC states that the "appendix was supplied at the request of the NDEP for the VLEACH model that was performed previously". This is not accurate. NDEP noted that the issue of model input parameters for the VLEACH model had never been resolved between NDEP and BRC. NDEP requested that BRC pull together all pertinent information and prepare a submittal with said input parameters and methodology that would be employed to evaluate the borrow materials. It was the goal of the NDEP to reach agreement on the methodology as part of the risk assessment work plan. BRC has not provided this information and it appears that BRC is deferring to present this information in the risk assessment report. The NDEP will review the proposed methodology when it is submitted. When this report is submitted it must respond to all previous NDEP comments on the VLEACH modeling as provided in the May 19, 2006 letter and any letters issued in the interim. Failure to do so will result in rejection of the risk assessment report without further review.

Response: *Please see the response to the Comment above. The new Table 1 containing the VLEACH input parameters should address NDEP's comments.*

iii. Table 2 of the current work plan appears to contain parameters that may relate to the VLEACH procedure and it is not clear how this relates to the remainder of the workplan. In addition, it is not clear which of these parameters may be site-specific to the locations that are identified to accept borrow materials. This issue should be clarified in the table and the text.

Response: *A comparison between Table 1 and Table 3 indicates that only one parameter, soil bulk density, is common between the two models (although soil moisture and volumetric water content are related). Also, for Table 3, these are for the construction dust model, which would apply to the Borrow Area soils, and not soils at the locations where the borrow material will be placed.*

iv. Appendix B should be removed from this document.

Response: *Appendix B has been removed. The new Table 1 contains the VLEACH input parameters.*
NOTE: Since the VLEACH modeling is applicable for where the borrow material will be placed, we will not have site-specific soil parameters. There are five soil parameters in the model: bulk density, effective porosity, volumetric air content, volumetric water content, and percent organic carbon. One or more 'generic' soil types will need to be identified and input parameters selected for this model depending on the location of the disposal site.

APPENDIX A-3
Response to NDEP Comments Dated May 19, 2006 on the April 2006 BRC Human Health Risk Assessment Work Plan, Revision 0

1. General comment, please provide a full, annotated response-to-comments letter as part of the response to this letter. In addition, a red-line mark up should be provided as well.

Response: *Comment noted. Consistent with other responses to comments, these will be included as Appendix A of the revised work plan report.*

2. General comment, apparent responses to previous NDEP comment #2 as discussed in the April 4, 2006 meeting, this comment discussed the need to discuss how to address asbestos and compositing issues, the NDEP would like to note the following:
   a. Discussion of guidance for how to handle asbestos has been augmented but issues related to compositing and the impacts on analytical sensitivity have not been addressed. At the April 4, 2006 meeting there was discussion about how the soil sample is fully re-suspended and then forced through an airway and filter. At that point it seemed that compositing was no longer considered necessary because we are already analyzing a 1 kg sample (roughly) which is a larger than the sub-sample used for almost any other form of chemical analysis. Coupled with the very low response (few detections), there is probably very limited value, if any, to compositing the samples before analyzing them. The NDEP is not categorically opposed to the idea of compositing, however, discussion on this matter should be included in the work plan.

Response: *The procedure used followed that in the Standard Operating Procedure for Surface Soil Sampling for Asbestos (SOP-12). This procedure was developed by D. Wayne Berman for BRC. The following text has been added to the end of the last paragraph in Section 5.3: "The method of sample preparation and analysis for asbestos involves collection of composite samples that are re-suspended and then forced through an airway and filter. Because of this, coupled with the very low response (few detections), there is probably very limited value, if any, to compositing the samples before analysis."*

3. General comment, apparent responses to previous NDEP comment #3 as discussed in the April 4, 2006 meeting, as discussed and documented in the April 4, 2006 Meeting Minutes, Item #5, background risk will not be evaluated. However, in Section 3.1 Evaluation of Site Concentrations Relative to Background Conditions, top of page 12, the revised Human Health Risk Assessment (HHRA) Work Plan states the following: "Also consistent with USEPA guidance (2002a), for chemicals that exceed their respective background levels, risks will be calculated considering both background and site-related risks. In addition, risks associated with background levels will also be presented for comparison purposes." Please remove this statement from the Work Plan.

Response: *The intent was to be consistent with the TRECO risk assessment and provide the background soil risks as a point of reference. However, as requested by NDEP, background risks will not be evaluated and this statement has been removed.*

4. General comment, apparent responses to previous NDEP comment #4 as discussed in the April 4, 2006 meeting, this comment discussed an expanded discussion of how the sand and gravel would be used and the processes by which the removal and segregation would take place.
   a. It is the belief of the NDEP that these issues have not been addressed in the current version of the document.

Response: *An expanded discussion on this has been included in Section 1.2 (Excavation and Processing of Borrow Area Material).*

   b. However, it is acknowledged that a sentence was added to Section 1.1, Site Description, page 2, last paragraph that stated "Once excavation begins, it is expected that Borrow Area soils will be excavated and screened on-site into a few grades of material (such as sands and gravel, etc.). These various grades then will be used off-site depending on customer needs." However, the Work Plan lacks details regarding the characteristics of these materials that may affect the transport modeling for inhalation exposures. For example, Table 2 of the HHRA Work Plan that contains the modeling assumptions for the re-suspension and dispersion of dust notes that soil property characteristics are pending. The text within the Work Plan under Section 2.1.1 Inter-Media Transfers (page 3) or Section 4.2 Outdoor Air (pages 16-17) does not discuss whether multiple modeling runs will be performed to assess potential risks associated with the different grades of material (sand, gravel, etc.) or how modeling assumptions will be documented. Additionally, the areal extent of the excavation will need to be accurate.

Response: *Separate model runs will not be performed for different grades of material. The only soil characteristic factored into the model is silt content. Sand and gravel content are not model input parameters. A uniform site-specific silt content will be used in the model. Silt is defined as soil particles smaller than 75 micrometers (µm) in diameter and can be measured as that proportion of soil passing a 200-mesh screen.*

5. General comment, apparent responses to previous NDEP comment #7 as discussed in the April 4, 2006 meeting, the NDEP has the following comments:
   a. Section 2 Conceptual Site Model and Summary of Data Usability Evaluation have been modified to better define the current and potential future receptors. This section also discusses the rationale behind eliminating potential ecological receptors from this HHRA Work Plan. Figure 2 has been modified accordingly. However, two issues have not been adequately addressed by BRC and are as follows:
      i. Although BRC clarified the current on-site and future off-site receptors, the HHRA Work Plan does not acknowledge the potential "nearby, off-site" receptors that may be impacted during mining and placement activities. Please include a discussion on how these receptors will be addressed in the HHRA. For example, will this be addressed qualitatively in the uncertainty analysis section based on the risk characterization for the onsite receptors?

Response: *The following text has been added to the end of the last paragraph in Section 2.1.2 and Figure 2: "Risks to potential nearby, off-site receptors that may be impacted during mining and placement activities will be addressed qualitatively in the uncertainty analysis section of the HHRA based on the risk characterization for the on-site receptors."*

ii. Page 2, 2nd paragraph, first sentence, please change "land use conditions" to "uses of Borrow Area soils". Please also add the word "future" between "potential and receptors" on line 4 of this same paragraph. In addition, please make a similar edit to Section 2.1.2 Potential Human Exposure Scenarios, first line, change "land use" to "Borrow Area soil exposures".

Response: *The text has been modified as requested.*

b. Page 4, bullet, Construction Workers (noted as associated with on-site soil), is there also a construction worker scenario for the placement of the soils as offsite fill?

Response: *This bullet has been revised to reflect construction worker exposures to both on-site soil and off-site fill material.*

c. The VLEACH modeling performed in 2005 is now an attachment to the HHRA Work Plan. This modeling was formerly a component to the Compilation Report for the Site. As previously stated, until the Borrow Area soil database is validated and a data usability evaluation is completed, it is premature to model a select list of chemicals that may or may not be chemicals of potential concern (COPCs) for the Site. At this time, we do not know if there could be other COPCs that were not modeled in 2005. We acknowledge that it will be the intent of the VLEACH modeling to determine the depth at which the Borrow Area soils can be placed so that future impacts to groundwater are avoided, thus making the groundwater pathway incomplete. Please revise the first paragraph found on page 3 of the HHRA Work Plan to state that the VLEACH modeling will be updated based on the COPCs identified in the HHRA. NDEP approval will be pending the results of the VLEACH modeling for the HHRA COPCs. Please also note a consistency comment. Within this same paragraph it was noticed that the term groundwater was spelled two different ways (ground water and groundwater). Please select the appropriate spelling and use consistently throughout the report. Additionally, detailed comments on the VLEACH model are provided below.

Response: *The text has been modified as requested. It is understood that additional VLEACH modeling will be conducted for the COPCs evaluated in the risk assessment or any other additional compounds that NDEP may request.*

6. General comment, apparent responses to previous NDEP comment #7 as discussed in the April 4, 2006 meeting, this comment discussed verb tense problems throughout the document, it is acknowledged that BRC has addressed most of these items, except for Section 2.2 Summary of Data Usability Evaluation, page 5, first paragraph, first sentence, please change "used" to "that will be used".

Response: *The text has been modified as requested.*

7. General comment, apparent responses to previous NDEP comment #10 as discussed in the April 4, 2006 meeting, this comment discussed apparent problems with the template used to develop the HHRA work plan, it is acknowledged that BRC has addressed most of these items, except for the following:
   a. Please correct a typographical error found in footnote #2, please change "nation" to "national";

Response: *The text has been modified as requested.*

   b. Section 6 Toxicity Assessment, page 21, first paragraph, please delete "(e.g., titanium)" within the sentence that states "Should COPCs be found which do not have established toxicity criteria (e.g., titanium), these…". Titanium has toxicity criteria;

Response: *The text has been modified as requested.*

   c. Page 23, second paragraph, please add a discussion similar to that for the TRECO HHRA that discusses the rationale for using pyrene as a surrogate for non-cancer effects associated with the carcinogenic PAHs.

Response: *The text has been modified as requested with a paragraph added to the end of Section 6 discussing this approach.*

8. General comment, apparent responses to previous NDEP comment #11 as discussed in the April 4, 2006 meeting, BRC has added a section that includes a site description (Section 1). Please include the investigation reports cited in Section 2.2.1 in the reference section of the document. As previously stated, NDEP assumes that a final validated site database, data usability, and data adequacy evaluation will be submitted to NDEP for approval prior to initiation of the HHRA. Please modify Section 2.2.1, page 6, accordingly.

Response: *The investigation reports cited in Section 2.2.1 have been added to the reference section. In addition, the last sentence in Section 2.2.1 has been modified to read: "The final soil database, data validation, and data usability evaluation will be submitted to NDEP for approval prior to initiation of the risk assessment."*

9. General comment, apparent responses to previous NDEP comment #12 as discussed in the April 4, 2006 meeting, while it is acknowledged that BRC discussed future ecological receptors in Section 2, current ecological receptors do not appear to be discussed. Please clarify.

Response: *The last sentence of the second paragraph of Section 2.1 has been modified to the following: "In addition, the Borrow Area is within the CAMU boundary and is not considered viable habitat; thus, current and future ecological impacts will not be assessed in the HHRA."*

10. General comment, apparent responses to previous NDEP comment #12 as discussed in the April 4, 2006 meeting, the NDEP could not locate a discussion on groundwater quality in the HHRA work plan.

Response: *The following text has been added to the last paragraph of Section 1.1: "As discussed in Section 2.1 below, exposure pathways associated with groundwater will not be evaluated in the HHRA. Excavations within the Borrow Area will stop prior to reaching groundwater. A full discussion on groundwater quality will be provided in the conceptual site model (CSM) being prepared for the CAMU. The objective of the various investigations and assessments within the Borrow Area were to demonstrate to NDEP that it is acceptable to use soil within this area as off-site fill material. Because locations for placement of Borrow Area soil as off-site fill material have not been determined, groundwater quality at these locations is unknown."*

11. General comment, apparent responses to previous NDEP comment #15 as discussed in the April 4, 2006 meeting, the NDEP has the following comments:
    a. Please verify the issue about the site being fenced and include in the HHRA Work Plan.

Response: *The CAMU boundary will be fully fenced to limit site access. Current access by individuals from the industrial facilities to the Stauffer/Pioneer/Montrose Ground Water Treatment System (GWTS), which used to be through the site, have been re-routed.*

    b. BRC states that the impacts to groundwater are evaluated in Appendix A. See other comments throughout this letter as the NDEP believes that this is not appropriate. This work plan does not evaluate all data associated with the site and the CSM for this site has not been completed.

Response: *This appendix was supplied at the request of NDEP for the VLEACH model that was performed previously, with input from NDEP at that time. The VLEACH modeling was provided as is for NDEP to review the input parameters that were used at that time to determine whether these were still appropriate. No additional VLEACH modeling and/or text edits were done to this appendix for the work plan. As stated in response to comment #5c above, additional VLEACH modeling will be conducted for the COPCs evaluated in the risk assessment or any other additional compounds that NDEP may request. The revised VLEACH modeling will be included in the risk assessment report.*

12. General comment, apparent responses to previous NDEP comment #16 as discussed in the April 4, 2006 meeting, the text in Section 2.2 does not appear to be logical. The QAPP and SOPs were not approved until after the data was collected and analyzed. BRC needs to revise this text.

Response: *The following footnote has been added to this section: "Both the QAPP and SOPs were under review and not yet approved by NDEP at the time of the 2006 Borrow Area sample collection."*

13. General comment, apparent responses to previous NDEP comment #17 as discussed in the April 4, 2006 meeting, the final database, data validation, data usability evaluation, and data adequacy evaluation must be submitted to NDEP for review and approval prior to initiating the HHRA.

Response: *See response to comment #8 above.*

14. General comment, apparent responses to previous NDEP comment #20 as discussed in the April 4, 2006 meeting, NDEP assumes that the comment will be fully addressed as a component of the data usability evaluation.

Response: *Comment noted.*

15. General comment, apparent responses to previous NDEP comment #25 as discussed in the April 4, 2006 meeting, footnote 3 of Table 1 should be edited as follows" For SVOCs, Method 8270C is the primary…".

Response: *The text of footnote 2 has been modified as requested.*

16. General comment, apparent responses to previous NDEP comment #26 as discussed in the April 4, 2006 meeting, the rationale for the "site-specific" parameters listed in Table 2 should be given. Additionally, Section 4.2 Outdoor Air, pages 16-17 should note that some of the site-specific data such as soil properties are pending (see also comment above). In addition, this section should include some discussion similar to that in the TRECO HRA regarding whether or not the volatilization factors (VFs) will be adjusted to account for construction activities or if this will be addressed in the uncertainty section.

Response: *The following footnote has been added to Table 2: "Site-specific values will be the average of all available data collected from the Borrow Area for a particular parameter."*

The following text has been added to Section 4.2: "The same volatilization factors will be used for all scenarios. The volatilization factors for the construction worker will not be adjusted to account for soil intrusion activities. Soil intrusion associated with construction activities could results in increased volatilization from the subsurface to outdoor. However, the volatilization factors to be used are conservative and are not likely to underestimate exposures."

17. Section 2.1.2, pages 4 and 5, the NDEP has the following comments;
    a. First full paragraph. The second constraint placed on Borrow Area soil fill refers to ambient conditions. This is a bit vague and needs to be clarified.

Response: *The text has been modified as requested with the following: "…they will not be exposed to ambient (surface) conditions".*

b. First full paragraph. The third constraint placed on Borrow Area soil fill refers to a minimum soil column height that will be maintained between where these soils are placed and the local groundwater such that impacts to groundwater demonstrated via the leaching evaluation are negligible. Have ground water fluctuations at the future, undetermined sites been adequately characterized such that this can reasonably be ensured?

Response: *Because locations for placement of Borrow Area soil as off-site fill material have not been determined, groundwater conditions at these locations are unknown. An evaluation of groundwater conditions at each location will be conducted to ensure that constraints on use of Borrow Area soil use are met.*

c. First full paragraph. The final constraint placed on Borrow Area soil fill is…" that it (Borrow Area fill) will not be placed in environmentally sensitive areas". The definition of environmentally sensitive areas needs to be clarified.

Response: *The following footnote has been added to this section: "These areas may include wetlands, National and State parks, critical habitats for endangered or threatened species, wilderness and natural resource areas, marine sanctuaries and estuarine reserves, conservation areas, preserves, wildlife areas, wildlife refuges, wild and scenic rivers, recreational areas, national forests, Federal and State lands that are research national areas, heritage program areas, land trust areas, and historical and archaeological sites and parks. These areas may also include unique habitats such as aquaculture sites and agricultural surface water intakes, bird nesting areas, critical biological resource areas, designated migratory routes, designated seasonal habitats, State designated Natural Areas, State designated areas for protection or maintenance of aquatic life, and particular areas, relatively small in size, important to maintenance of unique biotic communities."*

18. Section 2.2, page 5, it appears that this section only discusses the data collected in 2006. BRC needs to discuss all of the data that will be evaluated.

Response: *See response to comment #8 above.*

19. Section 3.1, page 12, third paragraph should be replaced with the following " The Wilcoxon Rank Sum test performs a test for a difference between two population measures of center. This is a non-parametric method that relies on the relative rankings of data values and the measure of center is quantified by the sum of the ranks in both Site and background data. Knowledge of the precise form of the population distributions is not necessary. The Wilcoxon Rank Sum test has less power than the two-sample t-test when the data are in fact normally distributed; however the assumptions are not as restrictive. The GISdT® version of the Wilcoxon Rank Sum test uses the Mantel approach which is equivalent to using the Gehan ranking system." Similar comments have been provided previously to BRC.

Response: *The text has been modified as requested.*

20. Section 3.1, page 13, the description of the Slippage test should be changed to "The Slippage test evaluates whether there are an unreasonable number of site data points that exceed the maximum background value."

Response: *The text has been modified as requested.*

21. Section 3.1, page 13, second paragraph should be replaced with "Typically an alpha = 0.05 is used to evaluate a statistically significant result. Since several tests will be conducted, a lower alpha is selected. As more tests are performed, it is more likely that a statistically significant result will be obtained purely by chance. Given the use of the multiple statistical tests, an alpha = 0.025 is selected as a reasonable significance level for the COPC selection. Any chemical that resulted in a p value less than 0.025 in one of the four tests will be retained as a COPC. Additionally, these tests are set up with one-sided hypotheses. Consequently, not only are differences between the two samples able to be detected, a directional determination can be made as well (e.g. Site is greater than background).

Response: *The text has been modified as requested.*

22. Section 4.1, page 16, third sentence should be replaced with "The UCL incorporates the uncertainty of the estimate of the mean and is the value that, with repeated sets of samples, will be greater than the true mean 95% of the time."

Response: *The text has been modified as requested.*

23. Section 4.1, page 16, 2nd paragraph: please provide additional explanation why a 95% UCL is appropriate for the soil scenarios and how the 95% UCL will be calculated for current on-site receptors (construction workers and trespassers) and future off-site receptors (construction workers and maintenance workers).

Response: *A description of how the 95 percent UCL will be calculated for each receptor is provided in the last paragraph in Section 4.1 ("Representative exposure concentrations for soil are typically based on the potential exposure depth for each of the receptors. However, given that the HHRA will assess exposures to soil following excavation and use as off-site fill material, it is proposed that a 95 percent UCL be generated for all data collected within the excavation extent and depth. This 95 percent UCL will be used for all potentially exposed receptors. For indirect exposures, this concentration will be used in fate and transport modeling.").*

The following text has been added to Section 4.1: "The 95 percent UCL of the arithmetic mean concentration is used as the average concentration, because it is not possible to know the true mean. The 95 percent UCL, therefore, accounts for uncertainties due to limited sampling data. An estimate of average concentration is used because: carcinogenic and chronic non-carcinogenic toxicity criteria are based on lifetime average exposures; and, average concentration is most representative of the concentration that would be contacted at a site, over time (USEPA 1992b)."

24. Section 5.2, page 20, third paragraph, paragraph under the formula should be changed. The estimate of the mean asbestos concentration is the number of asbestos fibers detected multiplied by the pooled analytical sensitivity. The upper bound estimate is the upper confidence bound of the mean number of asbestos fibers detected multiplied by the pooled analytical sensitivity.

Response: *This paragraph has been modified to the following: "Two estimates of the asbestos concentration will be evaluated. The estimate of the mean asbestos concentration is the number of asbestos fibers detected multiplied by the pooled analytical sensitivity. The upper bound estimate is the upper confidence bound of the mean of the assumed underlying Poisson distribution used to model the number of structures found multiplied by the pooled analytical sensitivity. The intent of the risk assessment methodology is to predict the amount of airborne asbestos which can be inhaled by a receptor. In addition, it will be assumed that asbestos only occurs at the soil surface (i.e., upper two inches)."*

25. Section 10, please add USEPA, 2004d to the reference list and cross check citations in the text with those in the reference list.

Response: *The text has been modified as requested.*

26. Table 1, please discuss and present an evaluation of how this table compares to the list of site-related chemicals and any site-related chemicals that were not addressed by this list of analytes.

Response: *The analyte list presented in Table 1 is that prepared by Daniel B. Stephens & Associates in their Revised Sampling and Analysis Plan to Conduct Soil Characterization of Borrow Areas, Henderson, Nevada. Any site-related chemicals not included on this table are:*

- *those that are primarily for water samples or for which toxicity criteria are unavailable (ions [bromide, bromine, chlorate, chloride, chlorine, chlorite, fluoride, nitrate, nitrite, orthophosphate, sulfate, and sulfite], dissolved gases [ethane, ethylene, and methane], aldehydes [acetaldehyde, chloroacetaldehyde, dichloroacetaldehyde, trichloroacetaldehyde, formaldehyde], general chemistry [ammonia, iodine, ph in water, sulfide, total inorganic carbon, total kjeldahl nitrogen, total organic carbon], organic acids [4-chlorobenzene sulfonic acid, benzenesulfonic acid, O,O-diethylphosphorodithioic acid, and O,O-dimethylphosphorodithioic acid], nonhalogenated organics [ethylene glycol, ethylene glycol monobutyl ether, methanol, propylene glycol], and water quality parameters);*

- *those for which toxicity criteria are unavailable (flashpoint), or toxicity is evaluated using surrogate chemicals (total petroleum hydrocarbons; risks evaluated using, for example, benzene, toluene, ethylbenzene, xylenes, and polycyclic aromatic hydrocarbons);*

- *those for which analytical methods were still being determined (white phosphorus and methyl mercury); and*

• those which were added to the site-related chemicals list after this investigation was conducted (PCB congeners [PCB-77, PCB-81, PCB-105, PCB-114, PCB-118, PCB-123, PCB-126, PCB-156, PCB-157, PCB-167, PCB-169, and PCB-189], 2,2-dimethylpentane, 2,2,3-trimethyl-butane, 2,3-dimethylpentane, 2,4-dimethylpentane, 2-methylhexane, 3,3-dimethylpentane, 3-ethylpentane, and 3-methylhexane).

The following text has been added to the last paragraph in Section 2.2.1: "These datasets do not include several chemicals that are on the project site-related chemicals list. A discussion of those chemicals that are on the site-related chemicals list but that were not analyzed for will be presented in the uncertainty section of the HHRA report."

27. Appendix A, the NDEP has the following comments:
    a. General comment, this section of the submittal is not of sufficient quality to warrant a detailed review. Several specific comments are provided below as examples. If BRC does not understand what is expected a clarification should be requested from the NDEP.
    b. General comment, throughout this Appendix, BRC discusses the 2003 and 2005 evaluations that were conducted. Neither of these were approved by the NDEP. BRC needs to instead discuss the process that will be completed to evaluate the entire dataset. This should include a detailed discussion of the input parameters and assumptions used to complete the evaluation.
    c. General comment, many of the comments below apply to other sections of the report. The NDEP will not spend the time or resources to identify these for BRC.
    d. Page 1, second paragraph, please discuss if the samples collected meet the requirements for use in a risk assessment. This is not covered under Section 2.2. above and needs to be.
    e. Attachment A-1, BRC includes the November 2003 evaluation that was not approved by the NDEP. It is not clear why this memorandum was included in this section of the work plan.
    f. Attachment A-1, Data Evaluation Section, this section has not been modified based on discussions with BRC regarding UCL calculations for the TRECO property. The NDEP will not reiterate those comments herein.
    g. Attachment A-1, VLEACH Section, since BRC has included this memorandum without modification, the statements regarding depth to groundwater are inaccurate.
    h. Attachment A-1, VLEACH Section, BRC needs to provide the reference for the four inch infiltration rate and any other parameters that are presented.
    i. Attachment A-1, VLEACH Section, BRC states that the site soils are similar to the City of Henderson (COH) WRF soils. This is a baseless statement that requires modification and supporting documentation.
    j. Attachment A-1, Table 1, as stated previously, this Table requires revision based on discussions provided by the NDEP previously.
    k. Attachment A-1, Table 4, this table presents data from the COH WRF soils, as stated above it has not been shown by BRC that this data is representative of the site and this is not acceptable. What is the relationship between the two sites that justifies this assumption? This is especially important as the parameter K(d) is directly proportional to the fraction of organic carbon content. For hydrophobic compounds this is probably the most significant factor in soil partitioning.

l. Figure 1, this Figure does not show the location of the groundwater well to the borrow areas. In addition, there is no scale or north arrow on this figure. The location of this measurement is inappropriate and the figure must be revised.
m. Attachment A-2, Table 3, the same comment provided above applies herein.

Response: *This appendix was supplied at the request of NDEP for the VLEACH model that was performed previously, with input from NDEP at that time. The VLEACH modeling was provided as is for NDEP to review the input parameters that were used at that time to determine whether these were still appropriate. No additional VLEACH modeling and/or text edits were done to this appendix for the work plan. As stated in response to comment #5c above, additional VLEACH modeling will be conducted for the COPCs evaluated in the risk assessment or any other additional compounds that NDEP may request. The revised VLEACH modeling will be included in the risk assessment report.*

APPENDIX A-4
Response to NDEP Comments Dated November 9, 2006 on the October 2006 BRC Human Health Risk Assessment Work Plan, Revision 3

1. General comment, please note that if BRC chooses to use sensitivity analysis to justify a conclusion, then the sensitivity analysis range must include the number being evaluated.

Response: *Comment noted. For sensitivity analysis, the analysis range will include the number being evaluated.*

2. Section 2.1.1, page 6, 2nd sentence. Please change "…this pathway has been evaluated elsewhere as a constraint to soil placement." To "…this pathway will be evaluated as…"

Response: *The sentence has been changed.*

3. Section 2.2.1, page 9, first paragraph, regarding completion and approval of all data validation reports. In addition to data validation, a data usability evaluation should be conducted prior to the completion of a health risk assessment (HRA).

Response: *A data usability evaluation, as discussed in Section 2.2 of the work plan, will be conducted prior to conducting the health risk assessment. This will be included in the human health risk assessment report to NDEP.*

4. Section 3.1, page 14, it is suggested that the results of all statistical tests, as well as observations regarding the plotted data, be considered when making decisions regarding chemical of potential concern (COPCs) based on background criteria. In other words, it is not necessary to conclude that chemical concentrations exceed background based on the results of one test; rather, a weight-of-evidence approach should be used.

Response: *Comment noted. A weight-of-evidence approach will be used in the evaluation of statistical tests for the selection of chemicals of potential concern.*

5. Section 4.1, page 18, BRC has previously stated that batch sampling will not be performed. The NDEP assumes that when 95% UCLs are used as the basis for soil exposure concentration, the input data will be documented as being representative.

Response: *An evaluation demonstrating the representativeness of the 95% UCLs will be included in the human health risk assessment report to the NDEP.*

6. Table 1, the NDEP has the following comments:
   a. Footnote e, BRC states "Values will be obtained from placement location materials tests or be representative of such locations. Initial model runs may use values shown below

from the VLEACH manual for a typical sand soil…" It is not clear why BRC would use default values if site-specific values are available. Please clarify what is intended.

Response: *Footnote e has been removed from Table 1. As indicated, site-specific values will be used in the VLEACH modeling.*

b. Footnote e, please note that the VLEACH user's manual values for effective porosity and percent organic carbon appear high for soils at the site.

Response: *Footnote e has been removed from Table 1. As indicated, site-specific values will be used in the VLEACH modeling.*

c. Please note that volumetric water content is not the same as irreducible water content. The number provided in Table 1 for volumetric water content (0.045) is listed in Appendix B of the VLEACH manual as the irreducible water content.

Response: *As indicated above, footnote e has been removed from Table 1. Site-specific values will be used in the VLEACH modeling. Specifically, field measurements of percent moisture have been collected. The percent moisture is the water content of a soil on a mass basis. However, the VLEACH model requires the water content in terms of volume rather than mass. Therefore, the percent moisture will be converted to the volumetric water content using the following equation: percent moisture × (bulk density / density of water); where the density of water is assumed to be 1.0 g/cm*^{3}.

7. Appendix A, Appendix A-1, general discussion, the NDEP has the following comments:
   a. BRC states that "most if not all of the Borrow materials will likely be usable in the BMI industrial complex itself". It is not clear to the NDEP what the purpose of this statement is. The same risk and groundwater protection criteria apply regardless of the location of placement of the material.

Response: *In the interest of providing additional helpful information, the discussion merely provided specific identification of where the Borrow Area soils will likely be placed. BRC agrees that the same risk and groundwater protection criteria will apply regardless of the location of placement of the materials. It is also possible that materials will be placed outside the BMI industrial complex.*

   b. BRC states that "It is also expected that, in most situations, the cover will also impede (or, in some cases completely block) infiltration." BRC continues in a later portion of this discussion to state "It should be noted that, in several proposed uses (such as base materials for a concrete building pad) there should be no infiltration at all." These statements are incorrect. Infiltration does not typically occur in a fashion where water travels straight down. Typically, infiltration also occurs from a certain lateral distance and water flows vertically and laterally in the sub-surface. It is not clear to the NDEP why this statement is included.

Response: *Regardless of these discussions, BRC will run the VLEACH model assuming direct vertical infiltration with no impediments at the top.*

8. Appendix A, Appendix A-1, response-to-comment (RTC) #2a, NDEP notes that BRC uses the term “effective porosity” in reference to its work with VLEACH. NDEP also notes that the referenced VLEACH manual appears to use porosity and effective porosity somewhat interchangeably. The manual provides a definition for effective porosity but does not appear to use it in its equations. If one examines Section 3 Mathematical Discussion in the manual, one notes that they use “porosity” in the equations and do not mention use of “effective porosity”.

The following calculations are provided for BRC’s reference.

a. Total soil porosity can be estimated from the bulk density.

$$n = 1 - \frac{\rho_b}{\rho_s}$$

where: ρb = 1.78 g/cm3 (original Table 1), and
ρs= 2.65 g/cm3 (quartz).

This yields n = 0.33 for total porosity with the given information. Comparing the calculated total porosity value with the reported effective porosity of 0.35, the value is higher than the calculated total porosity.

b. Alternatively calculating total soil porosity from the density reported in the current Table 1 yields:

$$n = 1 - \frac{\rho_b}{\rho_s}$$

where: ρb = 1.65 g/cm3, and
ρs= 2.65 g/cm3 (quartz).

This yields n = 0.38 for total porosity with the given information. Comparing the calculated total porosity value with the reported effective porosity of 0.35 (current Table 1), the value is still too high.

c. Soil saturation percent calculated from the porosity and soil volumetric water content:

$$S_s = \frac{\theta}{n} \times 100$$

where: θ = volumetric water content = 0.18 (original Table 1), and
n = porosity = 0.35 (original Table 1).

BRC’s proposed effective porosity (35%) for the sand and gravel mixture and the average volumetric moisture content gives a saturation of about 50%. If we use the calculated total porosity of 0.33, the soil saturation is estimated at 55%. The range of 50-55% appears to be on the high side for a sand and gravel mixture given the local climate.

Soil saturation percentage was not calculated using the value reported in the current Table 1 because the number reported in the table is incorrect.

The NDEP provides the information above on total porosity versus effective porosity and volumetric water content versus irreducible water content because these relationships must be understood to properly interpret and use the physical property analysis of the soil samples.

Response: *Comment noted. BRC reiterates that according to the VLEACH manual (Figure 8-14), soil porosity is not a sensitive parameter with regards to groundwater impact prediction. Regardless, site-specific values of porosity will be used as intended in the VLEACH modeling.*